Lectures on the germs and vestiges of disease : and on the prevention of the invasion and fatality of disease by periodical examinations : delivered at the Royal Infirmary for Diseases of the Chest / by Horace Dobell.

LECTURES

ON THE

GERMS AND VESTIGES OF DISEASE,

AND ON THE

PREVENTION OF THE INVASION AND FATALITY OF DISEASE BY PERIODICAL EXAMINATIONS.

DELIVERED AT THE ROYAL INFIRMARY FOR DISEASES OF THE CHEST,

BY

HORACE DOBELL, M.D.

ETC., ETC.

PHYSICIAN TO THE INFIRMARY.

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TO JOHN DOBELL, ESQ.

My Dear Father,

Although I chose my own profession, it was to your example that I owed the love of Science, and especially of Medical Science, which determined my choice.

It is now many years ago, but it is still fresh in my memory, that you used to impress upon me, during my early studies, the importance of keeping the mind free from the warping influence of prejudice, custom, and a blind obedience to authority, in all the investigations of Natural Science.

The experience of every year has shown me the wisdom of your advice; and, while appreciating in the highest degree the invaluable labours of others, I have sought to observe honestly and impartially for myself.

As these Lectures present a first sketch of the results of some of my labours in the wide field of Practical Medicine, let me have the pleasure of dedicating them to you, as a slight token of gratitude and respect

From your affectionate Son,

HORACE DOBELL.

London, Sept. 3, 1861.

PREFACE.

In consequence of the class of ideas which had been excited by the first few years of private practice,* I designed, in 1852, a form of Report for Cases, for the purpose of collecting certain classes of facts. This form I employed for two years, when I was obliged, by other demands upon my time, to adopt one much shorter and simpler in its details. With both of these forms some of my medical friends are acquainted, as I have to thank them, in several instances, for helping me to fill them up; but a copy of each will be found in the Appendix. The second worked very satisfactorily, and I continued to use it daily for four years, when want of time obliged me most reluctantly to give it up, and to keep much shorter notes of my consultations.

Much valuable matter was collected in these Reports; but the number of completely similar cases which they contain, is not, in my opinion, sufficiently large to justify a valuation of the facts by the statistical method. I mention this fact, because the views put forward in these Lectures are so intimately associated with the

* See Lecture II.

experience acquired in pursuing these plans of case-taking that I might, not unreasonably, be expected to present my readers with a tabular analysis of cases.

But, independently of this reason for omitting such statistics, it appeared to me that I should better establish the propositions advanced, if I could support them by facts observed by others and generally admitted to be true.

Such facts it was not difficult to produce, because I have always compared my own observations, and the views which they have originated, with those of the medical men whose friendship I enjoy, and of the best authors whose works I have been able to consult. And it has been my custom to collect the information thus gained, in the form of notes, under the headings of the principal diseases. The only difficulty, therefore, was to select from the mass of notes the most apposite extracts and to avoid overloading the text with quotations.

I have long intended to produce my accumulated materials in a systematic work on the Natural History and Genealogy of Diseases; and I had made considerable progress in the collation of notes with this design, when, last year, I was suddenly stopped by a severe illness; which showed me the impracticability of carrying out so comprehensive and elaborate a plan in the midst of the absorbing duties of a physician's life, and had thus the good effect of saving the profession, at least for the present, from the "infliction of a big book!"

The result was a determination to gather together the principal conclusions from my notes, with some examples of the facts, and an outline of the arguments by which

they are supported ; and to present them to the consideration of my medical brethren in the form of this short course of Lectures, addressed especially to junior practitioners of medicine.

I have thought it due to my readers, to enter into these details in explanation of the sketchy manner in which I have been obliged, by the comprehensiveness of the subject, to treat questions of difficulty and importance. I wish to assure them, that I estimate too highly the value of a medical man's leisure, to presume to occupy it, even thus briefly, had I not devoted much more of deep and serious thought to the subject of these Lectures, than may be indicated by the style which their oral delivery required.

Those who are not inclined to read the whole book may find in the Sixth Lecture a summary of the other five.

In conclusion, I wish to express my best thanks to Mr. Septimus Sibley, for his valuable assistance in revising the proof of the Fourth Lecture; and to Mr. Farrants, the accomplished president of the Microscopical Society, for his critical suggestions while the Lectures were in course of delivery.

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ERRATA.

Page 3, last Paragraph but one, erase inverted commas.
5, line 14 from top, *for* Fulmer, *read* Fulmar.
74, *for* Causes of Fatality A, *read* Cause of Fatality A.
130, line 16 from top, *for* uric acid, *read* lactic or uric acid.
140, line 9 from bottom, *for* uric acid, *read* lactic or uric acid.
159, line 3 from bottom, *for* dyspepsia, *read* dyspeptic.
165, line 11 from bottom, *for* affected by, *read* intended for.
172, Order I., *for* Hydraformia, *read* Hydriformia.

LECTURES

ON THE

GERMS AND VESTIGES OF DISEASE.

LECTURE I.

Articles of a Medical Creed—The Independent Powers of the Animal Organism examined—Law for the Attainment of the Ultimatum exemplified—Conditions of Existence—The V.M.F.—Altered Conditions of Existence in the higher Vertebrata—The Direction in which the V.M.F. is determined in the higher Vertebrata—Scope of the Normal Functions of Organs—The Force which disposes of Poisons.

Gentlemen,—We are justified in attempting the practice of our profession only in proportion to our belief in the articles of the following creed :—

1. That man may be the instrument through whom the invasion and progress of premature destructive changes in the human organism may be prevented or arrested.
2. That man may be the instrument through whom the damaged organism may be more efficiently repaired.
3. That man may be the instrument through whom the sufferings of the human being may be alleviated.

If, as I have asserted, the extent of our belief in these three articles measures our right to practise the medical profession, there can be no question of greater interest to us than an enquiry into their truth. To what extent and in what sense are they true?

It is a fortunate circumstance, that the truth of the third article is attested by such numerous and familiar facts, that it requires no demonstration here. That the

sufferings of animals, including man, can be relieved by the instrumentality of man, is beyond all doubt. And as this power to relieve pain would alone justify us in undertaking the practice of our profession, we may take courage from this assurance, while enquiring into the truth of the first and second articles, which are of much deeper importance.

To what extent and in what sense is it true that man may be the instrument in preventing or arresting the invasion and progress of premature destructive changes in the human organism, and in securing its repair when damaged by accident or by disease ?

This opens a wide field of the most interesting enquiry ; an enquiry beset with a thousand difficulties, associated with the labours of so many distinguished men, that every step we trace is sacred to the memory of some great name. Although the facts collected on this subject are numerous, many links are still deficient in almost every line of argument. It is almost impossible for me to treat it without either appearing to want respect for the opinions and conclusions of others, or wearying you by the length of the discussion. After mature consideration, I believe it would be wasting your time for me to attempt to lead you through the thick of the argument, fighting the way step by step, as we should be obliged to do, as we came into collision with the various theories and opinions which have been brought forward from time to time. I think I shall do better in the present place, and for our present purpose, if I lay before you for your consideration the results at which I have arrived, after a careful review of the facts in our possession, and of the arguments, opinions, and conclusions of others.

It is obvious, that before we can ascertain to what extent man is able to assist in promoting the repair or in preventing the destruction of the organism, we must determine the extent to which the organism itself is

capable of effecting these ends without the instrumentality of man. I shall, therefore, give this question precedence of the other, and at once assemble before you some of the principal instances which have been observed throughout the animal kingdom, in which the processes of *production*, *repair*, and *reproduction*, have been conducted by the organism alone.

These examples I have collected in the form of an Appendix to this lecture; and I have placed beside them some of the principal *conditions of life* surrounding the animals concerned. I have also added some quotations from different authors, to assist those not familiar with the subject in interpreting the facts. This Appendix has been printed; and I hope you have each been supplied with a copy, that you may look it over at home at your leisure.*

In this necessarily incomplete and heterogeneous array of observations, it is of the greatest importance that we attempt to discern the operation of some general law; under the governance of which the apparently incongruous facts may be seen in harmony, and to which we may afterwards refer, as a guide, when questions are presented to us concerning other facts of the same class.

The only general law which I feel justified in inducing from the facts collected may be expressed in the following words:—

"At every period of an animal's life, the force manifested in production, maintenance, growth, repair, and reproduction, is *sufficient in every respect, and determined in that direction*, essential at the time to the attainment of the ULTIMATUM."

The deduction from this law, applicable to any particular case afterwards brought before us, will be, that—

* See Appendix.

if the animal has not attained its ultimatum—the force will be determined to the conditions of existence; and, *cæteris paribus*, will be sufficient to maintain them.*

The term ULTIMATUM, which I have here employed, is intended to signify the consummation of the design with which an animal appears to have been formed. Thus, an insect, which exists under the form of ovum, larva, pupa, and imago, will not have arrived at its ultimatum in either the larva or pupa state; neither can the imago be regarded as the ultimatum, until it has secured the multiplication of the species, in the form of the necessary number of properly fecundated ova. In the case of man, if it has entered into the design of his creation that he should survive the period of fecundity, for the discharge of other duties in his maturer age, he cannot be said to have reached his ULTIMATUM when he has secured the multiplication of his species, but only when he has fulfilled his other functions in the world.

The point of especial interest in the application of this law is *the determination of the force* at each epoch of the animal's career, "in that direction essential at the time to the attainment of the ultimatum." The importance of this fact we shall see more conspicuously in a future lecture. In order to have a clear understanding of this law, we must constantly bear in mind, that throughout the animal kingdom from the lowest to the highest, the *individual* is subservient to the *species*—the design appears to be for

* CONDITIONS OF EXISTENCE.—"As nothing can exist without the concurrence of those conditions which render its existence possible, *the component parts of each must be so arranged as to render possible the whole living being, not only with regard to itself, but to its surrounding relations;* and the analysis of these conditions frequently conducts to general laws, as demonstrable as those which are derived from calculation or experiment."—(Introduction to BLYTH, WESTWOOD and CARPENTER'S *Edition of Cuvier's Animal Kingdom*, p. 15.)

the species—and that, therefore, the idea we form of the *ultimatum* must not be limited to the individual, but must be extended to the species. Hence, in watching the career of an individual of any species, if we see it cut short before its completion, we are not to conclude that the law for the attainment of the ultimatum has thus been violated or negatived.

To take an example. The number of offspring which must be produced to secure the multiplication of the species, is very different in different cases and must vary with the conditions of existence proper to that species.

"Thus the condor lays a couple of eggs, and the ostrich a score; and yet, in the same country, the condor may be the more numerous of the two. The Fulmer petrel lays but one egg, yet it is believed to be the most numerous bird in the world. One fly deposits hundreds of eggs, and another, like the *hippobosca*, a single one; but this difference does not determine how many individuals of the two species can be supported in a district. The real importance of a large number of eggs or seeds is to make up for much destruction at some period of life." (DARWIN, *Origin of Species*, p. 66.) When regarded in their full meaning, these facts may serve to demonstrate that the power of reproduction in each individual holds a special relation to the requirements of the species. Thus, each fly is provided with a power to generate hundreds of eggs, to compensate for the deficiencies of those other flies which may not attain to the production of any eggs, and for those eggs or young which may be destroyed at some period of their existence.

I hope you will carefully examine the list of facts which I have enumerated in the Appendix. They have been recorded by different authors to illustrate a variety of propositions, and are therefore strictly fair as applied to our present purpose. In one respect you will find them agree, viz., in the *adaptation of the reproductive and restorative powers*

to the conditions of existence, and to the attainment of the ultimatum. But I have failed, and I think you will fail, to assemble them all under any other standard than the law which I have attempted to enunciate.

The point of most especial interest, as I shall hope to shew you by and by, is *the direction* in which the reproductive and reparative force is exercised most prominently in each instance; it is to the restoration of that part the permanence of which at a particular time is a condition of the animal's existence, and which is by the circumstances of its life at that time most subject to injury.

Thus in the order Hydriformia, the locomotive powers are so limited and their habitat so exposed to enemies, that they would soon be exterminated, were they not provided with extraordinary reparative and reproductive powers. To meet this condition of their existence, they are not only enabled to restore lost parts, but the vegetable function of propagation by gemmation is extended to them.

Again, in the Asteriæ, whose rays form such prominent points of attack for the enemies to which their habitat exposes them, and at the same time are such essential conditions of their own existence, the reparative force is especially determined to the restoration of these rays. The completeness of this restorative power and the special need for it, may be daily witnessed when walking on the sands of our own coast, where you scarcely pick up a star-fish that has not one or more of its rays in some stage of reparation.

A very remarkable example of the force manifested in production or formation, determined in a particular direction in obedience to the law I am illustrating, is seen in the order Cirripedia. "The embryo, in the course of development," says Mr. Darwin, "generally *rises* in organization. . . . . In some cases, however, the mature animal is, generally considered, *lower* in the scale than

the larva, as with certain crustaceans. In cirripeds, the larvæ in the *first* stage have three pairs of legs, a very simple single eye, and a probosciformed mouth, with which they feed largely, for they increase much in size. In the *second* stage, answering to the chrysalis stage of butterflies, they have six pairs of beautifully constructed natatory legs, a pair of magnificent compound eyes, and extremely complex antennæ, but they have a closed and imperfect mouth, and cannot feed; their function at this stage is to search by their well-developed organs of sense, and to reach by their active powers of swimming, a proper place on which to become attached and to undergo their final metamorphosis. When this is completed they are fixed for life. Their legs are now converted into prehensile organs, they again obtain a well-constructed mouth, but they have no antennæ, and their two eyes are now converted into a minute, single, and very simple eye-spot." —DARWIN, *Origin of Species*, etc., p. 440.

It is evident, that in the second stage of this animal's career a large amount of force is required, and that it is made use of exactly in that direction pointed out by the conditions of existence. It is also evident, that this complex and elevated structure, to the production of which the force is determined, will require a proportionately large amount of force to keep up its nutrition; and this large demand and supply of force takes place at a time when the closed condition of the mouth prevents the introduction of fresh food. In the next stage, obeying still the law for attaining the ultimatum, the force is completely altered in the direction to which it is determined, and now no longer will support the beautiful antennæ and the compound eyes, but is directed to the maintenance of those organs for the digestion of food which have become conditions of existence.

In the larvæ of insects the powers of repair are especially active—the maintenance of perfection in the larva being an

essential condition of the production of the perfect insect. Thus Mr. Newport observed in the larva of *Vanessa urticæ*, that the organs of locomotion, so essential to the existence of both the larva and imago states of these little creatures, are susceptible of repair and reproduction at the change of skin and during the pupa stage of metamorphosis, and from a number of careful observations he arrived at this conclusion, that "it is sufficiently clear that a power of reproduction of lost parts is common to the whole of the insecta and myriapoda, and that it may take place in insects that undergo a complete metamorphosis as well as in those that do not change their form."

Rising still higher in the scale of animal life, to the Vertebrata, we find the power of reproducing lost limbs bestowed most largely on the salamander, an animal living among carnivorous feeders, and itself of predatory habits. Thus its limbs are placed in constant danger of mutilation, and yet are required as a condition of its existence. And in the land lizard, whose tail is at once a means by which the animal is apt to be captured, its instrument in eluding its pursuers, and in effecting its escape; a power to disengage it from itself is coupled with an extraordinary facility in reproducing the lost part.

In the fish, the persistence of the fins is a condition of its existence, and they are peculiarly exposed to injury, not only from constant use but from the attacks of enemies: and so do we find the power of repair especially determined to them.

We see then, gentlemen, in the facts I have collected in the Appendix, some of the simplest of which I have recapitulated:—

1. That under every condition proper to the different epochs of an animal's life, the formative or productive force is *sufficient in every respect* to the necessities of the case, and that it is especially *determined to the production*

of those parts most essential to the animal's career towards its ultimatum.

2. That the power to *maintain* the essential organs when formed, so long as they are required, is always forthcoming.

3. That the power to *repair or reproduce* parts injured or removed, is especially determined to those parts which are most essential at the time to the animal's career towards its ultimatum—those which are conditions of its existence.

And we arrive at the conclusion that the force which produces, maintains, and reproduces, is one and the same. The maintenance always follows the production; the reproduction follows when it is required for the security of the ultimatum.

Respecting the nature of this force I shall have more to say in a future Lecture; but as we shall frequently have to speak of it throughout the course—and it would be tedious and confusing to continually call it by the different names which have been applied to it, when exercised in the several functions of formation, maintenance, reproduction, and repair—I shall prefer adopting a mere *symbol* to represent it in one and all of its vitalized modes of manifestation.* I shall represent it, under these circumstances, by the letters (V.M.F.), which you will understand simply to mean *the force manifested in the production, maintenance, growth, repair, and reproduction, of the animal organism.*

We proceed now to the consideration of the highest class of vertebrata, including the human species, the

* (V.M.F.) Vitalized mode of Force.
(L.M.F.) Lifeless mode of Force.

"*Modes*, I call such complex ideas as, however compounded, contain not in them the supposition of subsisting by themselves, but are considered as dependencies on, or affections of substances."—LOCKE, *Essay on Human Understanding*, book ii., chap. 12, sec. 4.

repair and preservation of which is the immediate study of our profession. Among the numerous facts which might be cited, illustrating repair in man, I will select a few from which we may learn the *direction in which the V.M.F.* is especially determined.

I am not aware of any instance on record, in which a complete limb has been reproduced in man. But I think we may conclude from some facts before us, that this want of reproduction of limbs comes from no poverty in the V.M.F. necessary to produce them, were it in the plan of our creation—were it a condition of our existence—that they should be so reproduced. Speaking of the power of true reproduction after injury, Dr. Carpenter says:—"Its operations are frequently most remarkable; and are in no instance perhaps more strikingly displayed than in the *re-formation of a whole bone*, when the original one has been destroyed by disease. The new bony matter is thrown out, sometimes within and sometimes around the dead shaft; and when the latter has been removed, the new structure gradually assumes the regular form, and all the attachments of muscles, ligaments, etc., become as complete as before."—(*Principles of Physiology, Comparative and General.* 3rd edition. 1857. p. 872.)

Now, what are the principal constituents of a limb?

Bones, tendons, muscles, nerves, bloodvessels, lymphatics, skin and its appendages. Of these, we have already seen that the bones can be reproduced. I need hardly tell you that tendons, nerves, bloodvessels, lymphatics, and cellular tissue, are among the parts most truly reproduced in man. Of this, we have the testimony of Mr. Paget, in his incomparable "Lectures on Surgical Pathology" (p. 164, vol. i.); and of the reproduction of skin, Mr. Paget says (p. 287), "Its fibro-cellular and elastic tissues, its papillæ and epidermis are all well-formed."

Out of the important constituents of a limb in man,

then, here is evidence of the power to reproduce all but the muscles, and perhaps the glands. But beyond this, cases are on record in which supernumerary fingers have been reproduced more than once after complete removal. (See Appendix.) These cases are of remarkable interest: the occurrence of supernumerary fingers when once established is peculiarly *apt to be hereditary*. Many cases illustrative of this fact have been recorded, and some have come under my own observation. Now, whatever the influence may be under which a supernumerary limb or a new organ is produced in an individual and perpetuated by generation, we may fairly include it in the same class as the influence which determines the production and perpetuation by generation of some special organ peculiar to a species; and, as in the case of such organs, we have learnt that their reproduction after injury *is especially provided for*, so it would seem to be in the case of the supernumerary fingers or organs; showing that all that is necessary for the production of a lost limb in man, as in the lower animals, is the *determining influence* to divert the V.M.F. in the required direction. Dr. Simpson exhibited to the physiological section of the British Association (1850) numerous specimens, showing that after spontaneous amputation of the limbs of a fœtus in utero, at an early period of gestation, there had been an imperfect effort at the re-formation of the amputated parts from the stump; fingers had actually been produced on the stumps left by amputated hands. (CARPENTER, *Principles of Physiology, Comparative and General*, p. 872). In these cases, therefore, the strong tendency to secure the attainment of the ultimatum by producing a perfect embryo, appears to have partially overcome the inaptness to reproduce limbs in the human species.

I have brought these cases forward to show you that *the power* to reproduce a lost limb is possessed by the highest vertebrata—that it is not from deficiency of V.M.F. that

such parts are not reproduced, under ordinary circumstances, in man.

It remains, then, for us to discover in what special direction the V.M.F. is determined in the higher vertebrata, in place of those directions in which we have seen it determined throughout the other portions of the animal kingdom. If our general law is correct, the answer to this question will be found by ascertaining the conditions of existence peculiar to these higher vertebrata.

As we ascend the scale of animal life, we find a steady advance in the following particulars:

1. In the development of the *Nervous System.*
2. In the development of *Intelligence.*
3. In the complexity and delicacy with which *organs are correlated.*

With the advance of intelligence many changes occur in the conditions of existence. The chances of mutilation diminish, the animal becomes more fitted to guard against external dangers by precautions dictated by intelligence; and, by the assistance of his fellow-creatures, *man* is rendered much less dependent than the lower animals upon the possession of the external members of his frame.

With increased complexity and delicacy in the correlation of organs comes a proportionate increase in the importance and difficulty of keeping them repaired, as pointed out by Milne Edwards in the passage quoted in the Appendix. The more delicate and complex the instrument, and the greater the interdependence of its parts, the more is it liable to become useless through injuries of limited extent.

Increased development of the Nervous System introduces at once a large addition to the susceptibility to disease and to the number and diversity of its causes, especially exaggerated in the case of man by the addition of a moral and spiritual endowment intimately connected with his highly developed nervous system.

We find, then, as we ascend to the higher vertebrata, a combination of circumstances which entirely alters the conditions of existence.

We find the permanence of such parts as tails, fins, and limbs, cease to be a condition of existence, and hence we find the manifestation of force in this direction diminish. But there arises (as a condition of existence to which the V.M.F. ought to be determined) a necessity for the general repair and maintenance of completeness in the delicate and complex machinery upon which the life of the animal depends, and which its peculiarities render especially liable to damage.

How large a part a highly developed *nervous system* may play in increasing the susceptibility to disease may be gleaned from the following observations of M. Bernard, (*Lectures on Experimental Physiology*, Lect. 5, *Medical Times and Gazette.*) "To ascertain the circumstances which may be supposed to give birth to the accidental, transitory, and morbid idiosyncrasies, is to the physiologist a most important object of research.

"If we compare an animal in a state of abstinence with one in full digestion, the most evident discrepancies will be noticed in the results of experiments simultaneously performed upon them. A dose of strychnia which almost instantly kills the second, will not act before a certain lapse of time in the first. This difference is not due to *absorption*, because that is most active in abstinence. The *lowering* of the physiological activity of the *nervous system* is, in reality, the only cause to which the difference can possibly be referred. When deprived of food, the animal gradually sinks in the scale, and acquires properties altogether foreign to its previous state.

"There exist within the limits of health considerable differences between living beings . . . . . and these are not merely the result of organization, but frequently depend upon the condition in which the animal

has been placed. In this manner a rabbit may be brought down to the level of a Batrachian (by division of the spinal marrow). . . . . Now these important modifications are almost invariably produced through the agency of the NERVOUS SYSTEM.

"So exquisite is the sensibility of dogs *of the higher breeds*, that the slightest operations bring on fever, and are attended with alarming symptoms. . . . . In dogs of a more vulgar class, how different are the results of similar experiments! During the operation, the animal hardly attempts to move, and scarcely seems to suffer. The appetite remains unimpaired, and the secretions normal; in short, the various functions of the economy pursue their natural course."

"In the horse these differences are, if possible, still more strongly marked. The characteristics of certain breeds are, in colloquial language, attributed to *blood;* it would be more correct to attribute them to *nerves.* An irritable, sensitive, and highly organized nervous system is, in fact, the essential difference which separates a race-horse from one of those diminutive half-wild ponies which hilly countries so abundantly produce."

Seeing, then, the remarkable influence of the nervous system in the higher animals, we may readily understand how much greater this influence must be in man; and we shall expect to find, in obedience to the law for the attainment of the ultimatum, that as the V.M.F. ceases to be manifested in the reproduction of limbs in proportion as they cease to be conditions of existence, so in proportion as the complete correlation of a complex internal organization becomes a condition of existence, the V.M.F. will be determined in this direction, and this expectation is confirmed by the facts of the case.

Thus Tiedemann and Gmelin observed in the dog, which has no power to reproduce its limbs, that when the biliary duct was artificially obstructed, a new duct was formed

to connect the separated ends, and the patency of the tube was made complete. The same thing took place in the pancreatic duct when artificially ligatured by M. Bernard; and Professor Sédillot and M. Blondlot saw a new œsophageal tube produced after ligature of the natural canal.

These are but examples of a large class of analogous observations, which I need not take up your time by enumerating, as I am anxious now to pass on to the processes which occur in the human species.

I have already put forward for your consideration the analogy which exists between the *reproduction* at one stage of metamorphosis of limbs lost at a former stage, as in the larvæ observed by Mr. Newport, and the production of the compound eyes, complicated antennæ, and natatory legs, to serve a temporary necessity in the metamorphoses of cirripeds, recorded by Darwin; and I have proposed them as examples of the operation of the general law for attaining the ultimatum. I wish now to follow up that proposition by pointing out to you that, in the human species, a continual reproduction of parts is going on, which cannot be separated in any essential respect from the reproduction of lost limbs in the larvæ on the one hand, or from the repair of injured parts in the human organism on the other; and that all are represented in the development, for a temporary necessity in cirripeds, of a larva apparently requiring a determination of V.M.F. greater in every respect than is required by the perfect animal. The fact being that this V.M.F. is regulated only by the *necessities of the ultimatum*, and is determined under different circumstances in any manner that may be necessary to the general design.

I will call your attention first to the *formation of blood corpuscles*. You know that these organs are produced in the adult and in the child from the elements of the chyle derived from food; therefore, at these periods of life, they

have no need of any reproductive power within themselves; and, accordingly, we find them without such power, and without nuclei; but as long as the attainment of the ultimatum depends upon the power of the globules to reproduce themselves, as in the earlier stages of embryonic life before the elements of food are introduced, so long are the corpuscles provided with nuclei from which they reproduce themselves.

I refer, of course, to what physiologists call "the first set of corpuscles," which throughout the vertebrata are produced from the embryo cells of the vitelline membrane or germinal area, and gradually disappear as the second set take their place. (KIRKES' *Handbook of Physiology*, p. 66.) We have thus an example of special organs, endowed with reproductive power, introduced for a temporary office to secure the safety of the ultimatum; and in the continual supply of the second set of corpuscles we see an instance of the determination of the V.M.F. in a different direction to meet the altered conditions of existence. Again, we may observe with especial interest the process of secretion in glands and the maintenance of the cuticle. In the larva of the insect a leg is accidentally destroyed, or in the star-fish a ray is mutilated, and the conditions of existence require that the leg and the ray shall be restored. In the gland a number of cells are produced, and some call upon the organ for its secretion strips it of these cells, but they are quickly reproduced. So in the cuticle, epithelial scales must be reproduced continually for the simple maintenance of the tissue under wear and tear. In both cases the reproduction will take place, whether called for by the ordinary function of the part or by some occurrence which we please to term an accident. We see, then, that for the attainment of the ultimatum, *these so-called accidents have, within certain limits, been included within the scope of the functions of the organs.* To proceed further:—how shall we distinguish between that

function of a small blood vessel which leads it to contract on the application of cold, and that reparative power which it manifests when, some accident or disease having blocked up a larger channel in its neighbourhood, it gradually increases its dimensions, changes its subordinate position, and takes up the higher function of the other vessel. Or, when thus changed in size and function, some accident having divided its trunk, that quick and beautiful change for the arrest of hæmorrhage, with which you are all familiar, is set up in the divided extremity. We cannot hesitate to include all these several changes within the functions of the vessel.

To advance further illustrations of the direction in which the V.M.F. is determined in man. You will remember that, when speaking of the reproduction of limbs, I told you that I could not find an instance on record of the reproduction, in the highest vertebrata, of a complete muscle after removal by injury or disease. I now call your attention to the fact, that the power to produce *muscular fibres* to meet the exigencies of disease, when they involve the conditions of existence, exists in man. Mr. Budge, a German micrographer, has ascertained that the number of fibres in a muscle may be considerably increased under certain circumstances.

You are all aware that when, by accident or disease, an obstruction is placed in the course of the onward current of the blood, new fibres are added to the heart, and its whole muscular structure is increased in force and vigour, to overcome the impediment and thus meet a condition of existence. Here, then, is an exalted work of repair which we must again include within the functions of the organ—seeing that the V.M.F. is applied to this process as steadily as to its more ordinary duties.

Then I might enumerate a long list of instances of what has been called *vicarious secretion;* such as the excretion of urea by the intestines when the kidneys fail in their

functions. I might call to your mind the assumption of double or *supplemental* duties, when one of two symmetrical organs is damaged or destroyed. Then, again, you are all familiar with the active processes set up in the system when a little pus is formed in an internal organ:—how measures are taken to block it out from the organism at large; how it is gradually directed to the first safe point of escape—into an excretory tube or on to the surface of the body.

You know, also, that in cases of obstruction of the intestines by intussusception, the continuity of the canal may be restored by the removal of the impeding septum and the adhesion of the inverted walls of the canal to those by which it is received; and that these changes will take place under the unaided influence of the V.M.F. These are only a few familiar examples of numberless analogous cases which might be enumerated. But I will not occupy your time by needless amplification. I think we need not hesitate in concluding that the V.M.F., ever active throughout the animal kingdom in that direction most essential at the time to the attainment of the ultimatum, is especially determined in man to the preservation of completeness in the complex correlations of his organism, amidst the no less complicated dangers by which it is surrounded; and that preservation and repair under injury and disease are included within those functions of the organism to which the V.M.F. may be determined.

But an important question now arises as to the *limits* within which this preservative, reparative, and reproductive manifestation of the V.M.F. may take place. In general terms it is only limited, as I have said, by the requirements of the ultimatum. But I have attempted to show that this must be understood in a wide sense, as applying to the species, not to the individual. In the individual, the V.M.F. may be exhibited in its maximum or minimum degree. Hence, in any given instance, we are left to

determine by the circumstances of the case, in what degree it will be exercised.

The first point, however, in such a consideration, is to know what are the *possible* limits. The possible minimum we may fix at zero. The possible maximum will not be so easy to determine.

A comprehensive review of the facts in our possession illustrative of reproduction, leads us very near the conclusion arrived at by Mr. Paget, viz., that "in man and the other mammalia, *a true reproduction*, after loss or injury, seems limited to three classes of parts:—

"1. To those which are formed entirely by nutritive repetition; such as the blood and the epithelium.

"2. To those which are of lowest organisation and (which seems of more importance) of lowest chemical character, as the gelatinous tissues, the cellular and tendinous tissues, and the bones.

"3. To those which are inserted in other tissues, not as essential to their structure, but as accessories, as connecting or incorporating them with the other structures of vegetative or animal life; such as Nerve-fibres and Blood-vessels.

"With these exceptions, injuries, or losses in the human body are capable of no more than repair, in its most limited sense; *i.e.* in the place of what is lost, some lowly organised tissue is formed, which fills up the breach, and suffices for the maintenance of a less perfect life."—Lectures, vol. i. p. 164.

Accepting this for truth, as it certainly does not exceed the truth, let us pause to consider the extent of its application, and we shall find that it is much wider than at first we might suppose. Because we do not find the reproduction of complete organs, such as a lung, or a kidney, or even the perfect replacement of parts of organs, such as the valves of the heart or the lobules of the liver; because

we find that damages in such organs are repaired by tissues of lower organisation, as it were, with putty for wood, and stucco for stone, let us not fall into the mistake of undervaluing the importance of such kinds of repair. Regarded simply in a histological light they may appear clumsy and unsatisfactory; but if we view them with a wider vision we shall appreciate their manifold importance.

Let us bear in mind, that we are granted an almost perfect restoration of all those fluids and tissues necessary to keep up the nutrition and intercommunication of the different parts of the organism :—blood, gland-cells, epithelium, and the like; cellular tissue, tendons, bones, and the like; nerves, blood-vessels, and the like. The organs which cannot be so perfectly restored are either such as are seldom entirely removed without the death of the individual, or such as are provided with duplicates endowed with the power to assume a complemental function, or such as are competent in themselves to compensate for loss of a part by augmenting the functions of the remainder.

Let us take the lungs for an example; we have here one of the most vital organs of the body, provided with a structure eminently complex and delicate; yet of how small importance is it to the individual, that a few lobules are patched up with some lowly organised tissue and incapacitated for the performance of their function. We know by daily experience, that this may happen and the compensation by the remaining sound portions of the organ be so complete that the patient is not sensible of the existence of the damage. This lowest form of repair, then, answers every important end in such a case; and if we examine into it more closely, it is evident that under circumstances of disease or accident; that is, under the circumstances in which such repair is needed, expedition is the first consideration—anything to save time, to fill the

breach, to stay the progress of the damage, to save the life of the individual in the moment of peril. And not only does it serve in expedition, but in security. It is evidently more secure to fill the breach with comparative rubbish, than with a highly organised and delicate fabric, which would be in danger of the destruction that had just befallen its predecessor.

In short, gentlemen, we find that as regards the repair and reproduction of the human machine, everything is provided within the functions of the organism itself which is necessary to the attainment of the ultimatum.

But beyond this repair and reproduction, something more is required of the V.M.F., for the human being is placed amidst complicated conditions of life, as we have seen, and is surrrounded by other dangers than those included in *solutions of continuity*—by poisons organic and inorganic, by the whole army of influences commonly classed as causes of disease.

It will now be our business to consider whether any provision is made for protecting the ultimatum against such assailants.

To what extent is the animal organism capable of preventing the invasion and resisting the progress of premature destructive changes, without the intervention of man?

The simplest example of such attempts at the premature destruction of the organism may be found in the introduction of an inorganic poison, such as arsenic.

There is well known to be a poisonous and a non-poisonous dose of all poisons. What does this mean? How does it happen that the same substances may kill and may not kill? The answer is very simple. In the one case the substance is within the power of the organism to dispose of, in the other it is beyond such power. That the enemy is virtually *disposed of*, we learn from the fact, that the full poisonous dose may be given with impunity,

if divided into several smaller quantities and a certain time allowed to elapse between the administration of each, so that *one* may be disposed of before the action of the *next* begins. If these separate quantities were not in some way disposed of, the effect of the whole quantity would be experienced at last, as we find to be the case in those exceptional instances called "cumulative poisoning." We learn, then, that there is within the organism a force capable of dealing with poisons so as to avert their fatal effects, within certain limits; and in this place two questions present themselves:—

1. What is the force which thus disposes of poisons for the protection of the organism?
2. What are the limits within which it can act successfully?

To the consideration of these questions, we shall proceed in our next lecture.

END OF LECTURE I.

LECTURE II.

The Force which disposes of Poisons—The V.M.F., and favourable Circumstances—Hospital Studies and Private Practice—*The Times* Newspaper and Low Health—Empirical Treatment of Low Health unsatisfactory—The Power of the V.M.F., conditional—The V.M.F. susceptible of Change—Manifestations of Force, and Correlations of Force discussed—Conditions necessary to Normal Nutrition—Changes in the V.M.F. produceable and remediable—Inappropriate Terms applied to Force—Hypothesis of Accumulators of Force, and Transmission of Accumulated Force to succeeding Generations—Cuvier's Conditions of Existence, and Darwin's Natural Selection—Scientific and practical Conclusions.

GENTLEMEN,—In our last lecture we agreed that the symbol V.M.F. should represent the force usually described as "formative," "reparative," "vital," "restorative," "reproductive," etc.; and we arrived at a general law concerning the manifestation of this force, which may be called the law for the attainment of the ultimatum; and I observed that the idea we form of this "ULTIMATUM" must not be limited to the individual, but must be extended to the species.

We also arrived at the following conclusions:—

1. That, in accordance with this law, the V.M.F. in man is especially *determined* to the preservation of completeness in the complex correlations of his organism.
2. That, as regards *repair and reproduction* in man, everything is provided *within the functions of the or-*

ganism itself which is necessary to the attainment of the ultimatum.

3. That there is also included within the functions of the organism a power of *disposing of poisons*, so as to avert their fatal effects; but that this power is restricted by certain limits.

We now proceed to the inquiry :—

1. What is the force which thus disposes of poisons for the protection of the organism?
2. What are the limits within which this force can act successfully?

To answer the first of these questions, we have only to look to the normal physiological processes. You are quite aware that many substances essentially poisonous in their nature are continually formed within the organism itself during health, and that the maintenance of health requires and depends upon the constant disposal of these poisons,—upon keeping down their quantity below the poisonous dose. You know that this is the work of excretion, carried on continually under the influence of that force which keeps up the nutrition of the body—that force which, as we have seen, is the same as the force under which the body is originally formed. There is, then, no room to doubt that the same force which protects the organism against the undue influence of poisons generated within itself, protects it also against the poisons introduced from without. And this may be proved by experiment, for, if we select some poison capable of being generated within the organism, such as lactic acid or urea, and introduce it from without, we see the same series of effects follow in the one case as in the other. The beautiful experiments of my colleague, Dr. Richardson, illustrate this fact in a most admirable manner. Dr. Richardson injected solutions of lactic acid into the organisms of various animals by way of the peritoneal cavity; and the series of effects which followed, and the pathological changes in

the organs of the animals, detected after death, represented in a remarkable manner the symptoms and morbid anatomy of an attack of rheumatic fever, with endocarditis, in the human subject, due to the poison of rheumatism generated within the organism.*

Gentlemen, you do not need that I should point out to you how large a class of diseases, so called, are represented by the example of the poisons to which I have referred. The analogy is equally clear and simple between the processes set up by accidental attacks upon the organism, of other kinds than poisons, coming from without, and those set up by derangements within. I have already called your attention to the familiar fact of the compensating action of different organs, and of parts of the same organ. Whether the action be to dispose of some matter capable of doing injury by accumulation, or whether it be to perform a function for the generation of some matter without which injury would ensue; it is evident that the power to do the one or the other must be regarded equally as protective to the organism. That organs are continually both excreting and secreting to the relief of the duties of one another, is well known to you all. And so long as the tax thus thrown from one to the other is not too great or too prolonged, nothing occurs to derange the health. When, however, this balance is disturbed, some matter essential to the constitution of some other matter becomes deficient, or some matter collects in undue quantity, and, in either case, other organs and functions than those primarily involved are drawn into the service of the organism, to restore, if possible, the balance thus disturbed. And when we bear in mind the important fact that the normal constitution of any one part is dependent

* See a detailed account of these experiments in the "Astley Cooper Prize Essay, on the cause of the Coagulation of the Blood," pp. 371—396.

on the normal constitution of all the rest, we shall at once see how easily imperfectly-formed elements of nutrition may be generated in the organism, with all the features which we are accustomed to recognise as disease. How complicated may the processes become! how complex the outward manifestations! or again, how apparently simple! For all that may attract the physician's observation may be the last scene, successful or unsuccessful, in the attempt to get rid of a redundance or to supply a want.

No essential distinction, then, can be drawn between such processes as those to which I have here referred, and those which ensue when some animal poison is introduced from without, as the virus of small-pox or the infection of measles. Neither can they be distinguished from the changes set up by the sudden arrest of function in a secreting or depurating organ, or by the stasis of the blood itself under the influence of sudden transitions of temperature. No, gentlemen, as physiologists and physicians, we must recognise in all these changes the manifestation of the same force, and in the recognition of this wise and simple plan of our creation, the mind ascends in reverent wonder to the highest regions of contemplation.

We have now to answer the question,—What are the limits within which the V.M.F. can act successfully in arresting the destruction of the organism?

We might give the general answer which I have already applied to a similar question in relation to the repair of injuries, viz., that the V.M.F. is only limited by the requirements of the ultimatum; but as this is true only as applied to the *species*, and not to any given *individual*, it would not be a satisfactory answer. What we really desire to know, is the largest power to arrest destructive changes which is possible to an individual. I must confess my inability to give a general answer to the

question thus defined. We certainly know pretty accurately in what quantity some poisonous substances will be too powerful for the protective force to resist, but only then under *specified conditions*. Thus, I have already told you that M. Bernard has found that the dose of strychnine which will prove immediately fatal to an animal during full digestion, will not have the same action on the same animal during abstinence. It would be difficult to name any acute disease which has been inevitably fatal under all circumstances, and a single exception in such a case would not prove the rule, but must really prevent the establishment of any rule at all.

How strong and how abundant has been the manifestation of V.M.F. in special instances, it would be much more easy to tell.* Most men of experience

* I saw a very interesting case the other day, which illustrates the operation of the curative functions of the organism in a most remarkable manner. Mr. Lewis Bossy asked me to see Mrs. W., æt. 45, with him, "for the satisfaction of her friends," as she was apparently in a hopeless condition. Mrs. W. was a large and very strong woman. She had an enormous umbilical hernia, containing the greater part of the intestines. *She was in the eighth month of pregnancy, with her seventeenth child.* The hernia had existed about seven years, and had been supported by a truss; in spite of which, however, it had steadily increased in size, especially during the last few months of pregnancy, and the truss had of late altogether failed to keep it in place. When Mr. Bossy first saw her, four days before my visit, she complained of pain and tenderness in the left side of the hernial mass, and of nausea. The bowels had not acted for several days. She was unrelieved by treatment, and two days afterwards vomiting set in, which Mr. Bossy describes as becoming "grumous but not stercoraceous." This was attended with increasing prostration of strength, hiccough, and no action of the bowels.

On the following day, Mr. Bossy called in a surgeon, who thought an operation injudicious. After a long attempt, requiring considerable force and tact, the two gentlemen succeeded in reducing the mass, and secured it by a large padded metal plate and tight compress. No relief to the symptoms followed; on the contrary, they became

have seen cases in which patients have passed through a succession of the gravest diseases, one following the other without time for restoration between each, and have, at last, recovered from all with undamaged organs, and have been gradually restored to normal health. So do we sometimes see aged persons struggle through attacks of disease of a nature and intensity to which we might expect the young and vigorous to succumb. We cannot, then, define the limits of the power of the V.M.F. in dealing with disease, and we may, indeed, repeat and believe the trite axiom, "While there is life, there is hope." Nevertheless, it will be one of the highest duties

worse and worse, and the hernia escaped again during the night. The patient appeared to be rapidly sinking.

It was on the day following the reduction of the hernia that I saw the patient. She was continually retching—almost pulseless—the hernial mass very tender. A portion of the left side of the mass, at its lower part, was found to be deeply indurated, with a blush of inflammation on the skin surrounding a deep-livid bulla. I advised that the patient should be placed in such a position as to favour the gravitation of the mass towards this point, to which a warm poultice should be applied, and the whole supported on a pillow, while small doses of brandy and creosote should be constantly given; the object being to allow the natural powers to open the hernia, and discharge its contents externally.—It seemed a last resource pointed out by the organism. On the following day parturition set in, the patient was safely delivered of a living child, and the efforts during labour burst the gangrenous part, and produced a discharge of what Mr. Bossy describes as "a quantity of grumous matter and flatus, both of offensive, but not truly fæcal odour." After this the sickness ceased. The discharge "of flatus and grumous matter" continued at intervals for eight days, during which the patient gradually improved in condition. Healthy granulations were formed in the wound, and on the eighth day after delivery, the 17th of constipation, a discharge of fæcal matter took place from the bowels per anum. The bowels continued to act naturally, and the wound to heal, while the patient gained strength; and twenty-three days after the bursting of the gangrenous mass and the delivery of the child, the patient had resumed her truss, and was walking about quite well.

of the physician to learn to distinguish the circumstances under which an individual is likely to exhibit the V.M.F. in the maximum or minimum degree.

To sum up this portion of our subject in a few words, we learn that, in the perfect plan of creation, whenever life and the power to multiply have been given, there has been given also all that is necessary for the endurance of the one until the accomplishment of the other; we learn that the human organism is so constituted and endowed, that when produced it shall continue to exist, despite the causes of destruction that continually threaten to stay its course, until it has fulfilled its appointed functions in the world.

We learn, in fact, that (*under favourable circumstances*) the human being may live through injury, through disease, through almost anything, by its own unaided assistance.

After this assertion, you will perhaps think that I am about to make out the office of the physician or surgeon to be worse than a sinecure. But there is no need for such an alarm; you will soon see that there is plenty for both physicians and surgeons to do. Observe that small parenthesis (*"under favourable circumstances"*), and you will know that it involves a very sea of troubles to mar the otherwise easy task of nature. How seldom is this essential condition fulfilled! How seldom is the V.M.F. manifested under conditions which can be called favourable to its complete success!

Here, gentlemen, we are brought face to face with some plain questions which are intended to be the very life of these Lectures. W hat isthere for a medical practitioner to do? How ought he to do it?

It may seem strange to those who think they have finished their medical education, that I should put forward questions so trite; and they may feel disposed to answer me promptly and in very few words. I hope,

however, that you will have patience with me, while I attempt to give an answer of considerable length.

When I commenced private practice myself, I had devoted more time to the study of medicine in Hospitals and Medical Schools than most students have at their disposal; in addition to which I had read nearly every medical and surgical work of good repute, ancient and modern. And I naturally expected to find myself quite at home with any cases which might present themselves in private practice. To my surprise and disappointment, however, I found myself surrounded by complaints which appeared quite strange to me, and I kept vainly hoping that each new case might be placed under one of the well-known headings so familiar to me in the hospital ward, the out-patient room, the book, or the lecture theatre, and the management of which I had so carefully learnt.

Cases of pneumonia, apoplexy, variola, fever, or the like, were positively refreshing, when, from time to time, they came in their well-known features. But these were few and far between; whereas I found the principal part of my time occupied with diseases or states of health for which I could find no special names, and for which I had learnt no plans of treatment. Yet daily experience left no room to doubt, that I was in the very midst of those incidents which play so large a part in determining the happiness or misery of human existence.

This, gentlemen, I am aware is no new story, but just that which occurs more or less to every man when first he emerges from the hospital into the wide field of private practice. To the man who is determined to do his duty, it is a time of anxiety and perplexing doubts; and I hope I may be able to assist in clearing up some of those doubts and perplexities for my junior medical brethren.

Many years after the period to which I refer, an article appeared in the *Times* newspaper (August 4, 1858)—just

at the time that I was engaged in making notes for these Lectures—which appeared to be so apposite to this part of my subject, that I placed it with my notes; and I will read to you, now, a quotation from the article in question, which is full of interest and meaning:—

"Amid all the dangers that threaten the health of this metropolis, there is a sad certainty more serious than any one of them. . . . . What is it that is worse than a sweating sickness, or a plague, which comes with a bale of Turkish goods, and goes with a Great Fire, which wears itself out, and leaves no record but in story, which old men may describe to wondering grandchildren, and which doctors may now set down as an individual and extinct type of disease? *It is not disease, but it is not health.* It is a low state of vitality, of physical power, of mental energy, of enjoyment, and even of moral strength. A timid parent may ward off every danger from her children only to reserve them for this. While she is afraid of burning sun, drenching rain, wet grass, and sloppy roads, of pistols, sharp knives, flying stones, and deep streams, of rude companions, bad words, and horrid examples, of infection, contagion, fruit-stalls, and maturer seductions,—of everything, in fact, that in one form or another is sure to assail everybody when he steps out of doors and mixes in society, old or young, she is all the time raising a poor, weak, if not absolutely sickly, hot-house plant. He is acquiring no solidity, fibre, or nerve. Mind and body, if he is not positively bad, he is not good for much. Bred without sun and wind, or those social influences which are the sun and wind of the soul, he stagnates, shrinks, droops, and languishes,—retires into himself, or, from sheer want of resistance, falls an early prey at his first encounter with the actual world. Now, that is what we have before us in the inevitable fate of this immense population. . . . . It is almost a matter of course in such a

metropolis as ours that, do what we can, all we can promise the great mass is low, feeble, dull health.

"To understand this, and be too sure of it, we have only to take a walk through any of our populous quarters —Shoreditch, Bethnal-green, the Borough, Lambeth, all the river side, Clerkenwell, Gray's-inn-lane, and those numerous smaller districts of which the working classes, for one reason or another, have obtained inalienable possession. Take them at the hours when they show,— going to their work, or returning from it, or making their purchases, or cooling themselves in the open air. Look at them, and please remember that when you have deducted half a million people rather better off, there remain two millions of the sort you see before you. Can it be possible that they boast the same blood, the same country, the same wholesome diet and generous nature as the JOHN BULL of story? Whither have fled his rosy hue, his cheerful smile, his round outline, his plump cheeks and brisk gait? That is the myth; this is the fact. . . . . Divest the crowd of everything that may be considered peculiar and accidental. Take the average, or rather the whole, without exception; and reflect that *these are the children that are to be our future men and women, —these before us are the men and women that are to give us more children*, to breed them, to teach them and train them, and make them men and women. Shocking as it may seem, a plague once in twenty years seems but a light evil to so low a condition of humanity."

These remarks are directed chiefly to the very poor, but it is not they alone who suffer from states of health here so forcibly portrayed. Many of the conditions of *low health*, and of anomalous disease to which I have referred, are more frequent among the well-off than among the poor.

The frequent recurrence of cases presenting similar groups of symptoms; the careful examination of these,

and attempts to give relief by treatment, to the patients' complaints; the comparison of successful and unsuccessful attempts to interpret symptoms and adapt remedies; these means, there can be no doubt, enable most intelligent men, in course of time, to *treat* such cases with a certain amount of success. But, gentlemen, such empiricism is fraught with continual annoyance and vexation, and can never long give satisfaction to the enquiring mind. What I wish to impress upon you is, that these cases are capable of a more general interpretation; that they are intimately connected with the definitely-marked diseases to which names have been allotted — those diseases with which we meet in such large numbers in hospitals, and which are also scattered throughout private practice.

We have seen, gentlemen, that there is within the organism a power to preserve life in nearly all forms of disease, *under certain circumstances;* and daily practice confirms the truth of this proposition; while it shows us also that nearly all forms of disease may terminate in death, *under certain other circumstances;* and, again, that whereas nearly all forms of disease, failing to destroy life, may leave some damage to the organism *under certain circumstances*, those same forms of disease may occur *under other circumstances*, and leave no injuries behind.

What, then, are those all-important circumstances associated with such different results? In other words, how is it that the same disease, so called, may appear and disappear, leaving no loss of life, no damaged part, in one person, at one time; and in another person, or in the same person at another time, the same disease shall destroy life or leave a damaged part?

When we have answered these questions, we shall be very near discovering both "What there is for a medical practitioner to do," and "How he ought to do it."

I hope, in the course of these Lectures, to answer these questions. I hope, indeed, that the answers will suggest themselves to you, as we proceed to develope our subject.

Hitherto we have considered the V.M.F. only in its normal condition and relations; in that state, in fact, in which it may be believed to exist in the perfect and healthy animal surrounded by normal conditions of life. We have next to consider it in regard to the possibility of its being susceptible of change,—the possibility of its losing those powers of sustaining life and of repairing the organism under injury and disease, which we have learnt that it possesses in the normal condition.

I venture, gentlemen, to put before you the following proposition:—THE V.M.F. MAY BE ALTERED IN ITS ATTRIBUTES OF QUANTITY AND QUALITY BY NUMEROUS CAUSES.

In attempting to discuss this proposition, I am fully aware of the difficulty of the subject; and I frankly confess my conviction that I am not competent to do it justice. This difficulty is increased by the insufficiency of our present discoveries; and all questions which relate to force are necessarily beset with uncertainty, from the fact that they extend beyond the limits of human knowledge, and hence we can only follow them so far as those limits permit. I trust, therefore, that you will bear these difficulties in mind in case you think my remarks either illogical or unsatisfactory. I wish, however, to assure you of this, that the *conclusions* which I eventually bring forward for your acceptance, shall not at all depend for their truth upon any *hypotheses* which I may suggest. These hypotheses are only intended to rank as the *explanations* which appear to me to embrace the largest number of facts, and which are therefore most entitled, for the present, to be regarded as the true interpretations.

Force, gentlemen, is only known to us by its results,

and when we attempt to seek the answer to the question, What is force? we are carried, as I have said, beyond the limits of human knowledge. But great advances have been made of late years in the knowledge we possess of the manifestations of force, in which Mr. Grove has prominently taken the lead. I presume that you are familiar with his admirable writings on this subject, and with the works of those authors who have followed it up in more especial relation to our own profession.

To remind you, however, of the light in which I wish you to regard *force*, to bring the idea which I wish you to form of it forcibly to your minds, I will recall to your recollection some of the most lucid passages from the writings of these authors.

"The position which I seek to establish in this essay," says Mr. Grove, "is that the various *affections of matter* which constitute the main objects of experimental physics, viz., heat, light, electricity, magnetism, chemical affinity, and motion, are all correlative, or have a reciprocal dependence. That neither, taken abstractedly, can be said to be the essential cause of the others, but *that either may, produce or be convertible into any of the others.* Thus heat may mediately or immediately produce electricity, electricity may produce heat, and so of the rest, each merging itself as the force it produces becomes developed: and that the same must hold good of other forces, it being an irresistible inference from observed phenomena that a force cannot originate otherwise than by devolution from some pre-existing force or forces."—Grove, "*Correlation of the Physical Forces*," p. 15. 3rd edition. 1855.

"The term *force*, although used in very different senses by different authors, in its limited sense may be defined as *that which produces or resists motion.* Although strongly inclined to believe that the other affections of matter, which I have above named, are and will ultimately be resolved into *modes of motion* . . . . . it would

be going too far, at present, to assume their identity with it; I therefore use the term force, in reference to them, as meaning that active principle inseparable from matter which induces its various changes." — GROVE, *ibid*, p. 16.

"In investigating the relations of the different forces, I have, in turn, taken each one as the initial force or starting point, and endeavoured to show how the force thus arbitrarily selected could mediately or immediately produce or be merged into the others; but it will be obvious to those who have attentively considered the subject, and brought their minds into a general accordance with the views I have submitted to them, that no force can, strictly speaking, be initial, as there must be some anterior force which produced it. We cannot create force or motion any more than we can create matter. Thus, to take an example previously noticed, and recede backwards; the spark of light is produced by electricity, electricity by motion, and motion is produced by something else—say a steam-engine—that is, by heat. This heat is produced by chemical affinity, *i. e.*, the affinity of the carbon of the coal for the oxygen of the air: this carbon and this oxygen have been previously eliminated by actions difficult to trace, but the pre-existence of which we cannot doubt, and in which actions we should find the conjoint and alternating effects of heat, light, chemical affinity, etc. Thus tracing any force backwards to its antecedents, we are merged in an infinity of changing forms of force; at some point we lose it, not because it has been in fact created at any definite point, but because it resolves itself into so many contributing forces, that the evidence of it is lost to our senses or powers of detection; just as, *in following it forward* into the effect it produces, it becomes, as I have before stated, so subdivided and dissipated as to be equally lost to our means of detection."— GROVE, *ibid*, p. 212.

"In all phenomena, the more clearly they are investigated, the more are we convinced that, humanly speaking, neither matter nor force can be created or annihilated, and that an essential cause is unattainable. Causation is the will, creation the act, of God."—GROVE, *ibid.*, p. 217.

Dr. Carpenter attempted to carry forward the views of Mr. Grove from the physical to the vital manifestations of force; and, in 1850, he communicated a paper to the Royal Society, in which he says:—

"Believing, as the author himself does, that all force which does not emanate from the will of created sentient beings, directly and immediately proceeds from the will of the Omnipotent and Omnipresent Creator (which is evidently the idea entertained by Locke), and looking therefore at what we are accustomed to call the physical forces, as so many *modi operandi* of one and the same agency, the creating and sustaining Will of the Deity. . . . his present object is to show that *the same relation* (in whatever way defined) exists among the several vital forces, whose operation may be traced in living bodies, as exists among the physical; and that the vital and physical forces are themselves connected by a similar relationship. And as the mode of expressing that relationship, without any hypothetical assumption, he would state his idea of the correlation of two forces, A and B, to be this:—A, operating upon a certain form of matter, ceases to manifest itself, but that B is developed in its stead; and that, *vice versa*, B, operating upon some other form of matter, ceases to manifest itself, but that A is reproduced in its stead. The idea of correlation, also, involves that of a *certain definite ratio* or equivalent between the two forces thus mutually interchangeable; so that the measure of force B, which is excited by a certain exertion of force A, shall, in its turn, give rise to the same measure of force A as that originally in operation."—"*On the mutual Relations of the Vital and Physical Forces*," by

W. B. Carpenter, M.D., F.R.S., etc. Philosophical Transactions, 1850, p. 730.

"Thus we have in operation, in the simple growth of a vegetable cell, a force closely allied to chemical affinity, but so far different that it can only be exerted through a living organism, a force of assimilation or vital transformation and complete vitalization. In speaking of them as distinct forces, it is only meant to affirm that their manifestations are diverse."—*Ibid.* p. 732.

"The animal, however, deriving its nutriment from organic compounds previously elaborated, does not perform that preliminary operation which is so remarkably intermediate between chemical and vital agency, viz., the production of ternary and quaternary compounds of complex atomic constitution by the union of their elements."—*Ibid.* p. 736.

You will understand, then, gentlemen, that the terms "formative force," "reproductive force," "reparative force," signify only those several manifestations of force of which we become cognizant through the operations of formation, reproduction, and repair. These same manifestations of force were long spoken of by medical writers under the name of the "vis medicatrix naturæ," which M. Bernard proposes to call the "physiological state." Thus, in his lectures on physiology, he says:—

"The 'vis medicatrix,' so long considered as a sort of mysterious power concealed within the living body, is the mere result of physiological properties, which though cast into the shade, as it were, by the disorders which attack the economy, still continue to exist, and in most cases gradually regain the mastery. When, therefore, death occurs, instead of saying that life has been overpowered, it would be more correct to say that the '*physiological state has ceased to exist.*'"—"*Lectures on Experimental Physiology,*" by M. C. Bernard. Lecture 10.

Seeing, then, that there are affections of matter insepa-

rably connected with the phenomena of life, the force which becomes manifest in such affections of matter may not inappropriately be specialised by the term "vital." "Vital force," therefore, is an expression to which there can be no scientific objection, except the danger of its being understood to mean a force originating in living things. In fact, it matters not by which of these names we call the force, so that we clearly understand that it is no *new* force, but the same as that manifested in lifeless things under the various affections of matter treated of in experimental physics, but now manifested in vitalized things under the various affections of matter treated of in physiology. I believe, however, that when we wish to express an idea involving a complex explanation which we cannot continually repeat, the purity of the idea is much more likely to be retained when represented by a symbol than in any other form of expression. It is for this reason that I have chosen the symbol (V.M.F.) to represent force whenever it is manifested in the affections of matter inseparable from the phenomena of life, and the symbol (L.M.F.) to represent it under every other mode of manifestation. (See Lect. I., note to p. 9).

To return, then, to the proposition with which I started.

The only knowledge we have of the existence of force, whether manifested in vitalized or in lifeless things, is inseparably connected with matter. The only knowledge we have of different modes of force is inseparably connected with different modes of matter. Therefore, so far as our cognizance of any mode of force is concerned, the necessary concurrent modes of matter are the "conditions of its existence."

It is evident, therefore, that as this force (V.M.F. or L.M.F.) is dependent, for the modes of its existence, and hence for its attributes, upon the concurrence of certain modes of matter, so of necessity it is subject to changes

in its attributes by changes in those concurrent conditions which render them possible.

Hence the truth of my proposition, that "the V.M.F. may be altered in its attributes of quantity and quality by numerous causes."

The chief conditions necessary to normal nutrition have been epitomised by Mr. Paget, as follows:—

1. A right state and composition of the blood or other nutritive material.
2. A regular and not far distant supply of such material.
3. (At least in some cases) a certain influence of the nervous system.
4. A natural state of the part to be maintained.

You will observe, that these expressions refer to the materials which shall be brought to the builder's hand, the mode of their delivery, and the work to be done; but the wide and safe terms "*right state and composition*" and "*natural state,*" which Mr. Paget has judiciously employed, must be taken to include in their meaning that all these conditions of matter are so correlated, that they shall manifest a right state of V.M.F. The importance of such a right state, and of its dependance upon the physiological conditions, we have abundant opportunities of observing in medical practice. I must beg of you to keep clearly in your minds the distinction between defects in the administration of force due to imperfections in the organs through which it has to act — of which I shall speak hereafter — and defects in the attributes of the force itself—of which I am now treating.

You may, perhaps, find it difficult at first to reconcile the mind to the idea, that the V.M.F. can be influenced either quantitatively or qualitatively by the circumstances incident to the individual. But this idea is, in my opinion, so important to the right practice of medicine, that I have been most anxious to make it clear to you.

Its importance will be apparent at once, if you call to mind the great differences which we daily observe in what are called the vital powers of any number of persons we may examine: in some, we say the vital powers are satisfactory; in others, unsatisfactory; and we are accustomed to expect from experience, that the effects of injury or disease will be materially influenced by these varieties of vital power.

If you bear this in mind, I say, you will at once see the importance of the proposition I have been seeking to establish; because, if the V.M.F. is subject to differences and defects as *manifested in different individuals*, and yet is *not subject to change from the circumstances under which it is manifested*, then, not only have we no means of accounting for the introduction of the differences which we witness, but we must conclude that those differences are irremediable. Whereas, in the other case, they must be regarded as *both produceable and remediable*.

It has been too common to consider the force exhibited in the operations of life, (the V.M.F.) *as a given quantity*, to which no accessions can be made, but which is apportioned to each living being in quantity sufficient for its necessities, according to some hidden law; and that throughout the life of that individual, the force becomes gradually expended until it ends. Even those who admit that the primordial cell or germ does not contain the organising force for the whole organism, and who believe in the correlation of forces, yet treat of the force when manifested as though it were a given quantity, gradually undergoing "consumption" or being "expended." In this way they unfit the mind for the appreciation of appropriate ideas respecting the susceptibility of the force to change with changes in the external world. Thus it is stated, "that a larger amount of organising force is *expended* in development than in growth or maintenance, and that the reparative power bears an inverse

ratio to the amount of force already *expended* in the processes."—PAGET, *Lectures on Surgical Pathology*. Vol. i. p. 156. And again, "that the reparative power bears an inverse proportion to the amount of power *consumed* in the development and growth of the individual and in its maintenance in the perfect state."—*Ibid.* p. 154. And, again, it is said, that, "the power which can be exercised in a germ is limited," and that, "the power thus limited is in some measure *consumed*, 1st, in the development of every new structure; and, 2ndly, in a less measure, in the growth and maintenance of those already formed." —*Ibid*, p. 154. These expressions are apt to convey the idea that the force is subject to waste, annihilation, or consumption, but not to restoration or replenishment.

In the first Lecture, when treating of the manifestations of V.M.F. throughout the animal kingdom, I attempted to show you that the *law for the attainment of the ultimatum*, while it sufficiently accounts for the facts by which the foregoing conclusions of Mr. Paget have been justified, includes also those other facts which have been admitted to militate against them.

So in the present instance, I shall attempt to give you an explanation of the facts which have been observed, relating to changes in the V.M.F., which shall include a larger number of those facts than any other hypothesis with which I am acquainted, and shall, at the same time, be in consonance with the law for the attainment of the ultimatum.

According to the most recent statistics employed by actuaries, it may be calculated, that out of every 100,000 children born, only 63,296 reach the age of twenty-five years; 36,704 dying from various causes before that age. If each of these 63,296 individuals has, at the age of twenty-five, produced one child and $\frac{7}{12}$ths, the number thus obtained will be only a fraction more than is sufficient to compensate for loss, and to bring the population

up to the original quantity. In order, then, to keep up the population, the V.M.F., with which each individual was endowed at birth, must have accumulated at least $\frac{1}{1\frac{1}{2}}$ths during life, instead of wasting, expending, or being consumed; otherwise, the individuals of each successive generation, would be endowed with a smaller quantity of force than their predecessors. And as, so far from the population being only maintained at a fixed quantity, it increases at a great rate, the accumulation of V.M.F., must be proportionately great. To fulfil this necessity of organic existence, we discern—or at least such is my hypothesis—that every living thing is given, 1st, a certain *endowment of V.M.F.*, with which to begin its career; 2ndly, *accumulators* of fresh force; the amount which it can thus accumulate being regulated only, *cæteris paribus*, by the requirements of the ultimatum.

This endowment of force, I believe to be inseparable from the endowment of matter, in a vitalized mode, with which every living being must be sent into the world; and these accumulators of force I believe to be inseparable from the accumulators of material, with which we are all familiar, and of which no one will doubt the necessity.

Thus do we see that the first condition of existence in the plant is the evolution of the radicle and plumule from the seed, by which force and material may be accumulated from the inorganic world. In the animal, the first condition of existence is the capacity of the young to obtain food, and thus to accumulate force and material. This is seen also in those tribes of plants and animals which multiply by *gemmation*; that is, "in which multiplication is effected not only artificially but spontaneously, by the separation of parts which, though developed from the same germ in continuity with each other, are capable of maintaining an independent existence; and which, when thus separated, take rank as distinct individuals."—(CARPENTER.) It is

extended also to the mere zoospore of an *ulva* or *conferva*, (which "is nothing else than a young cell from which the entire organism is to be evolved"—(CARPENTER), but which is provided with the power of accumulating by *osmotic* action,) no less than to the highest form of animal existence with all its complicated apparatus. Upon this provision of accumulators the transference of force from the inorganic to the organic world depends, no less than the transference of inorganic matter into organised compositions—the two processes are coetaneous and inseparable. It may be stated then, as a conclusion from these premises, that the V.M.F. in the highest animals is continually accumulated, by *a succession of transferences*, from the inorganic world by which they are surrounded. It is then no more than a postulate, to affirm, as I venture to do, that in this manner the constitution of the animal, both in material and force, will be dependent on the conditions of the world in which it exists, subject to alterations correlative with those of that external world itself.

Granting thus much, I must lead you at once to the next step in the hypothesis, viz., that some of the force thus accumulated passes into the germs of the vitalised being. The V.M.F., like other manifestations of force, is neither expended nor annihilated, but passes on. Some of the force manifested in development, growth, maintenance, and repair, passes on into the germs of new cells and tissues, and again is passed on from the *entire organism* into the germs of a new generation.

The multiplication of the species having been thus secured, the body performs its final office; having provided for its descendants the force necessary to the commencement of their vital career, it makes the world at large its "residual legatee;" the force in the organism not now needed for the regeneration of parts or the multiplication of the species, passes gradually

away into the world around, as the organic constituents of the frame gradually degenerate and wear out; until life being at length extinct, the remaining matter is yielded up to the action of oxygen and the consequent process of decay; thus, the residue of the force and materials is contributed to the external world, to be again accumulated by succeeding generations.

According to this hypothesis, gentlemen, there will be no "antagonism between the operations of generation and development," and the familiar example brought forward by Dr. Carpenter, as indicative of such an antagonism, is deprived of all antagonistic meaning. "Between these two operations" (generation, and development—including budding), says Dr. Carpenter, "there would seem to be a kind of *antagonism*. Whilst every act of *development* tends to *diminish* the germinal capacity, the act of *generation* renews it; and thus the tree, which has continued to extend itself by budding until its vital energy is well-nigh *spent*, may develope flowers and mature seeds, from which a vigorous progeny shall spring up."

According to my version of these phenomena, the tree which has been extending itself by budding has not been spending or exhausting its vital energy at all; on the contrary, this extension has been coequal with the accumulation of vital energy, or, as we call it, V.M.F. This V.M.F., instead of being "spent," when it ceases to manifest itself in the continued extension and budding of the tree, has simply been determined in another direction, consistent with the conditions of existence, in obedience to the law for attaining the ultimatum: the V.M.F., as it ceases to be required, and ceases to be manifested, in the development of buds and leaves, is gradually passing on into the germs of a new generation; and hence, that development of flowers and maturation of seeds to which Dr. Carpenter refers with so much surprise. That each

of these seeds should be competent to originate a tree similar to the parent, would indeed be extraordinary, if it were produced by a parent of which the V.M.F. was already spent; but there is nothing extraordinary in the fact on the hypothesis that, with the extension of the processes of life in the parent tree, force and material were accumulated from the inorganic world, and that this accumulated force and material were divided among the seeds, in quantity similar to that with which the seed was endowed from which the parent tree originated.

If I am right in affirming that the constitution of the animal, both in material and force, is dependent on the conditions of the external world, from which that force and material are accumulated, and if I am right in concluding that some of this force passes into the germs, and thus on into the organisms of the next generation; then the law of the *conditions of existence,* insisted on by Cuvier, becomes invested with a new dignity and importance; for not only will these conditions determine the existence of the organic being which they surround, but will carry their influence forward to the next generation, which will thus be assimilated to the conditions into which it is born. In this manner, there will be maintained a constant correlation between the forms of organic life brought into the world and the conditions on which they depend for their existence. It does not appear that Mr. Darwin has recognised the influence which may thus be exercised by the "conditions of life." If my hypothesis is correct, it will lend new importance to his theory of "natural selection," and it will supply, in part at least, an element which some of his critics have thought wanting.

Whether or not Mr. Darwin is right in attributing the *origin of species* to natural selection, few can dispute the fact that such natural selection occurs universally throughout nature; that the being which is best suited, whether in body or mind, to the conditions of life in

which it is placed, will be the one to survive in the struggle for existence, and thus prove the propagator of its species.

According to my hypothesis, then, the descent is determined by the conditions of existence; not only, as Darwin says, by selecting the forms of life most suited to them, but also *by assimilating every generation to the conditions into which it is born, and thus favouring the characteristics on which its selection will depend.*

I fear, gentlemen, that you may have found this dissertation upon force uninteresting and tedious. I think, however, that I have been justified in troubling you with it by the importance of the scientific and practical conclusions with which it is associated; conclusions which are based upon well-observed facts, and which the foregoing hypothesis is intended to explain.

The scientific conclusions are as follows :—

1. That the V.M.F. may be altered in quantity and quality by numerous causes.

2. That these causes may affect either the existing individual, a succeeding generation, or both.

3. That these causes are—*principally*—the vestiges of disease, existing or *coetaneous diseases*, and the *conditions of life*. — By the conditions of life, I mean the circumstances which surround the living being, and which are not confined to, but include the *conditions of existence*.

The practical conclusions are these :—

1. That the vestiges of disease, coetaneous diseases, and the conditions of life, may determine the efficiency or non-efficiency of the V.M.F., to prevent or arrest the invasion and progress of premature destructive changes in the organism, to secure its repair when damaged, to produce an offspring, to endow that offspring with V.M.F. of normal quantity and quality.

2. That abnormal conditions of the V.M.F., either congenital or acquired, may be changed by changes in the conditions of life and by means which exert an influence on the vestiges of disease; and that the influence of such changes may affect not only the individual but a succeeding generation.

Before concluding this Lecture, I must briefly dispose of one other proposition, viz. :—That numerous changes by injury, disease, and repair, may occur in a part by which its relation to the normal V.M.F., may be altered. The truth of this proposition is so obvious, that I need not occupy your time by discussing it; I will only observe that the term *part* must be understood to include the blood and other fluids of the body, as constituting most important *parts* of the organism, especially subject to changes, and especially connected with the manifestation of the V.M.F. I must remind you, also, of the intimate interdependance which exists between the functions of any one part and those of every other part of the organism, to which I have already referred.

To sum up in a few words. We have arrived at the conclusion :—

That the effects of injury or disease and the manifestation of the V.M.F., in protecting, restoring, or repairing the organism, depend upon the relation which exists at the time between the following conditions :—

a. The position of the animal and of the part affected, at the time, with respect to the attainment of the ultimatum.

β. The state of the part affected and of all correlated parts.

γ. The state of the conditions of life at the time.

δ. The quantitative and qualitative state of the V.M.F.

We have now finished the physiological introduction to our subject. And in the next Lecture, I shall begin the practical consideration of disease; through the wide fields of which I hope to take you by a sort of cross-country trip.

END OF LECTURE II.

LECTURE III.

A Cross-country Trip—Medical Men are both Travellers and Guides—The Wells and Springs of Disease—A Day's Practice, Cases Illustrating the Germs and Vestiges of Disease, and Favourable and Unfavourable Circumstances—Why does one Man die and another recover from the same Disease?—Conditions influencing the Effects of Injury and Disease, and the Manifestation of V.M.F.—Degrees of Defect in the V.M.F.—Essential and Predisposing Antecedents of Disease—Causes of Fatality in Disease—Examples of Disease selected from the Registrar's Report—Plan of Analysis.

To-day, Gentlemen, I must ask you to forget these grim walls for a moment, and each of you to imagine yourself in some country place that has been familiar to you from childhood, prepared to accompany me on a cross-country ride. Although we go across country, we shall by no means abandon the beaten roads when they serve our purpose; but when they do not, we shall certainly disregard the proprietors of hedges, fences, and ditches, and make these also succumb to our purpose.

You are perfectly familiar with that road which leads from the village to the wood, up which you have so often sauntered; you know quite well the path to the mill—your favourite evening walk. But I shall just trot you up the lane at the end, and show you over that thick hedge on the bank, when you will see that your road to the wood and your path to the mill run so nearly parallel and so close together, that the road will take you to the mill, and the path to the wood, by a very slight turn indeed. I shall take you a gallop to the lake in the

valley, which you always believed had its source in that swampy wood on its higher bank; and we shall then climb the hill to your favourite well under the beech trees, and to the little stream that runs from it, and loses itself under the rocky side of the mountain ridge. You know these spots well from childhood; but I shall take you through the brambles and furze on the ridge, and down through the quarries on the other side, and show you your little stream gushing from the rocks again, and tumbling down the hill-side to the swampy wood. I shall not be stopped by notice-boards, warning off trespassers, or by your legends of the dangers of the place. We shall be careful of our footing, however, and perhaps dismount and lead our horses slowly through the worst of the stones; but down we must go in spite of them, and prove to you that it is your favourite well under the beeches, after all, which makes the wood a swamp, and fills your fine lake in the valley.

I am convinced that you are wrong, notwithstanding the testimony of your oldest inhabitants, when you tell me that the church on the hill, to which you have walked every Sunday these twenty years, marks the highest point in the county. It certainly looks from your village and from your usual rides as though it might; but come with me across the country, and, screened by those tall trees which appear to skirt the horizon, I will show you a hill almost up to their tops, from which your church is seen enveloped in the valley mists.

Now change the scene, and return to life in town. Let us take our course across the ups and downs, the quicksands and the thorns, which beset the study of disease and health. It is still a cross-country route I wish to take you; but don't misunderstand me—don't suppose that I wish you to leave your "hand-books" behind, or to forget one item of what you have learnt about the usual ways and by-ways, the well-known objects of interest, and

the public places. No guide is justified in penetrating to the interior, till he has learnt all the roads well worn by his predecessors, so that he may recover the safe track if he finds himself getting into danger. *We* must ever remember, gentlemen, that, as medical men, we are not *travellers* only, but at the same time *guides*; that while we are exploring for ourselves we are always leading others. We must never forget that we have no right to take our patients with us through any perilous expedition of discovery, so long as a sure road is open to even a less promising goal. At least, we have no right to do so without their full appreciation of the perils, and their consent or desire to incur them for the prospect of the better end.

The journey which I propose to you, however, is not a perilous one—no experimental trip. I wish to take you through scenes most of which are familiar to you, but to take you in the cross-country fashion, and show you them under new aspects and in new relations to one another. I wish to show you which roads run parallel and close together, but hidden from each other, and, although apparently leading in different directions, in truth both opening into some one other road which conducts them both to the same end. I wish to show you the *wells and springs of disease*, of which we so easily lose sight, while busy with the disasters of which they alone have been the cause.

First come with me into the consulting-room, and after seeing what we can there, accompany me on my round through the streets and squares of this great city, and see disease and death in the order in which we happen to meet them, without regard to nosological arrangements.

Patient, Number One, enters while we speak. Be still, and observe his agitated address, the flush about the forehead and upper part of his face, the unsteady eyes wandering

about, as though in search of words sufficiently expressive to impress us with the importance of his case. How anxious he is to tell us his long list of pains, discomforts, anomalous sensations, dismal forebodings, vague apprehensions, assurances that he is not "nervous," and that nobody understands his case. How anxious to tell us all this in a breath, as though he feared we might form a wrong opinion of him before examining him with sufficient care. Mark especially the peculiar falter in his speech, by which a syllable or word is now and again dropped, as though the force from behind suddenly failed, and the sound went back into the larynx instead of being uttered.

Now feel his pulse, beating 140 to the minute—sharp pelting beats, which may or may not have force, but certainly are vastly agitated. The stethoscope to his heart reveals no morbid sound, but it is projected against the ear sharply with every systole. And mark his anxious and excited look, as he tells you at once that he knows you will find the heart diseased, and he is prepared to hear the worst. Mark, also, the expression of want of confidence, I may almost say *disappointment*, when you tell him you detect no heart disease. He is dreading, though only twenty-one years old, that you are setting him down as nervous and hypochondriacal; in fact, he has always been told either that he was nervous, or that he had a disease of the heart; of which opinions, he is sure to prefer the latter; the truth being, that his sufferings are so oppressive to him, that he is inwardly convinced there must be serious organic disease. Now, ask him a few questions he has not answered in his own story of the case. First, we learn that his urine is very uncertain in character; sometimes scanty, sometimes abundant, sometimes pale, sometimes deep, but continually recurring to a high colour, and a copious deposit of urates on cooling; and if we examine it we find crystals of uric acid. His appe-

tite is most probably good, but he suffers great inconvenience at the epigastrium directly his stomach is filled; and a little malt liquor or a glass of sweet wine sets his heart palpitating, and brings on a whole list of troubles, and yet he is rather fond of both the beer and the wine. Then his bowels are very irregular, often suddenly relaxed; he is very chilly, too; he complains that, although apparently warm, and although well-clothed, he is always subject to a feeling of chilly discomfort, with occasional sensations of cold water creeping about his back and limbs; another of his troubles is sleepiness at inconvenient times; he can't read without getting sleepy; he wants to sleep after eating; he sleeps at church, at the theatre, or if waiting for a friend; and yet, very likely, his nights are sleepless and disturbed. We probably learn, on further enquiry, that a parent or grand-parent, and some of his uncles or aunts have had rheumatic fever, or that one of his brothers or sisters is affected like himself, or has had rheumatism. The diagnosis we form from these and other symptoms is, that he is saturated with the poison of rheumatism; that he is only waiting for some chill to give him an attack of rheumatic fever—the vestiges of one state of health are ready to become the germs of new diseases.

The corpulent flabby old lady, who appears at summons No. 2, has a shorter tale to tell; she has a symmetrical patch of chronic psoriasis on each leg; and is, as she calls it, "teazed to death with erysipelas of the ears and sides of the head." We soon find that instead of erysipelas, it is eczema; and in one of her eyes we see an advanced and very yellow cataract. We pass her through a strict examination, and discover that she is saturated with the poison of gout, or rheumatism, most probably gout, which is acting as the germ of these several forms of disease.

The next patient is a little child, with large grey languid eyes, and a very white skin. She is decidedly fat, but the plumpness gravitates a little—it rather drops from the cheek-bone—and there is a blueish cast below the eyes; she looks very amiable, does everything she is told intelligently, but without vivacity; she is very heavy to lift, not so much from her actual weight, as that she gives no assistance; she is what is commonly called a *dead weight*. On examining the abdomen, it is found larger than natural; the spine is straight; the legs are straight; but the breath is very offensive; and we learn that the appetite is very uncertain and fickle. The child has of late fallen off her play, soon tiring of exertion, and inclining to sit still; she is not troublesome, but likes to be quiet, and if asked what's the matter, says only that she is "tired, and her legs ache." She likes to lie uncovered at night, and perspires a good deal about the head and forehead. The stools, too, are often light-coloured, and the water generally pale and frequently thick.

These symptoms we learn from the mother, *not spontaneously*, but by close questioning; for we have fixed our attention on the wrong patient. It was not the child but the mother herself who wanted advice. She does not think there is anything particular the matter with the little girl, and is not very willing to believe that she requires medical attention. We shall urge it upon her strongly, nevertheless; for although not suffering from any special organic disease, the little patient is gradually drifting into rickets; and should any simple disease, such as measles, occur in her enfeebled organism, it will probably acquire a fatal type.

Now let us turn to the lady herself. We may well forgive her, that she did not see her little child was seriously ill; for she is too exhausted to have much acuteness of observation or energy for action. She has

been married five years and two months; has had three children, each of which she has nursed for twelve months. The little girl we have seen is the second child, and is two years and eight months' old. The mother was thirty when she married; and although a healthy strong girl, she had gradually lost strength in her womanhood. Her marriage had been postponed, to suit the wishes of her parents, that she should wait till her intended husband had attained a certain position in society, and could bring her a liberal income. It was during these years of anxious delay that her health first declined; and from a fresh-blooded, vigorous girl, she had become, at the time of her marriage, anæmiated and depressed in spirits. She nursed her children twelve months each; in fact, "till another was coming," at the persuasion of her friends, as the essential claim to the title of a *good mother!* She is still nursing her third child, and we now learn that she has reason to think she may be a mother for the fourth time. The object of her visit to us to-day is, indeed, to seek relief from the troublesome sickness and loathing of food, which are threatening to take from her the little strength she has. She tells us she has been weak and low for years, and *does not expect to get over that;* in fact, she has come to regard her health and everything else in the same spirit of passive endurance as she showed about her child. And can we wonder at it! Can we wonder at the condition of either the child, or the mother; or fail to see the sort of prospects which await the little one to come! The vestiges of disease in the mother have begotten other forms of disease in her organism, which have become the germs of mischief in her offspring.

Next comes a man who at first rather puzzles us. We see in his face that he is ill. He looks cadaverous, dark under the eyes—not black but blueish; he appears ill-nourished, and yet his station in life ought, at least, to

secure him sufficient food. He is the responsible manager of a large commercial establishment, has a good salary, a wife, and a comfortable home, not very long hours, and a holiday once a year. He says he is puzzled at his own state; he takes good food, lives regularly, and walks every day to and from business, but, nevertheless, he feels "going to the bad." The only complaint he can specialize is constant aching of the limbs, a constant feeling of being over fatigued, without any apparent cause, and disturbed rest at night from the weary aching of the legs and back. We examine him thoroughly without detecting any diseased organ; but we learn that when at business, he sits in a badly-lighted office, close to a large cistern which supplies the works with water, that the office is warmed by a gas stove, and that, in consequence of the responsibility of his post, he cannot get away to meals, and he therefore takes them in his office; and, on inquiry into their constitution, we find that he lives upon meat, bread, and tea; that for some years he has eaten vegetables or fruit only on Sundays when dining at home. These circumstances give us the clue to his suffering, and we know that we are only just in time to save him from purpuric exudations of blood in some part of his body, by which organs might be damaged, and new forms of disease set up.

The sixth patient is a gentleman of sixty, the proprietor of quarries in Wales, and a director of several public companies in London, a very active, energetic man. But these occupations require that he should frequently travel long journeys by rail, and be able to sit out protracted board meetings. He is repeatedly incapacitated for both of these duties by the malady for which he seeks advice. For thirty years he has been harassed by diarrhœa—not constant, but frequently recurring—setting in severely with very little notice, and excited by such a variety of

trivial causes, that he never feels confidence that it may not return at the most inconvenient time. The most frequent cause is some slight change in the temperature of the atmosphere, or in the warmth of his dress—anything, in fact, which chills the surface of the body. The purging is very urgent for a time, and on more than one occasion, has continued so obstinately as to threaten his life, in spite of medical assistance. Usually, the attack lasts about two or three days, and then subsides, and for a short time he remains *unaffected by the causes which before might have excited the disease.* It has continued all this number of years without any sensible permanent effect from treatment, and, of late, has been getting worse.

The articulations of the fingers are somewhat enlarged, and there is a mitral systolic bruit at the heart. The liver, too, is below its normal limits, smooth, but rather hard, and in explanation of the marks of cupping in the hepatic region, we learn that he has several times been supposed to suffer from congestion of the liver. He never had the gout, but there is a strong hereditary history of that disease; and his brother, who is of fuller habit, has had more than one attack in the foot.

A few more details, and some analyses, satisfy us that the diarrhœa is due to the excretion of gouty poison in the bowels; and that we may pretty confidently promise to instruct him how to keep it in subjection—how to keep free from those vestiges which are in him the constantly recurring germs of other diseases.

The next case (7) is clear enough. A sallow-faced, emaciated lady of fifty, who, with nervous, quivering lips, tells us how she has been a martyr to facial neuralgia for several years, how her strength has steadily given way under the suffering, and the positive absence of appetite which accompanies it; how nothing has ever done it permanent good, although she has at times had temporary

relief. The paroxysms are periodic with regard to the time of day *in each attack*, but the particular hour adhered to in different attacks varies extremely, and although there are distinct attacks, during which the paroxysms are of much greater severity, she is never entirely free from slighter paroxysms, and at any time in the day or night acute darts of pain may be excited by touching the skin of the face, or by the contact of food with the mucous lining of the lips. She increases her weakness by abstaining almost entirely from fermented liquors, from a fear of aggravating the rushing noises in the head which frequently accompany the pain. She is displeased at our suggesting that she may have lived in an ague district, and thus contracted her complaint; for she assures us that she always derives benefit to her health from a visit to her son *in Essex*, which she makes every year, and tells us that it is her native place, and she never had neuralgia till she left it and lived in London; that she never had ague but once, and that was in London, some time after leaving Essex. We examine her spleen, and find it enlarged.

The case explains itself; and we are obliged to impress upon her that so long as she continues her annual visits to her son, we have no hope of permanently curing the neuralgia, because we believe that the neuralgia is constantly regenerated by the vestiges of the malarious poisoning which she annually renews.

A glance convinces us that the short-breathed, white-faced man who now enters so silently, with an aspect threatening syncope, is the subject of fatty degeneration. He must have a glass of brandy directly, lie on a couch till he is revived, and come for a more leisurely examination another day. For we must now start on our round, and proceed at once to a patient whom we left insensible late last night, and hardly expect to find alive.

On arriving at the house the man is dead. He had been sinking for some time before we first saw him; last night he had become unconscious, and during the night and this morning his medical man has been watching beside him as he gradually passed out of life, without disease and without suffering. He was eighty-two, and died of simple decay.

The story of his life, however, is full of interest to us in a medical point of view. He was born in a country district; the son of a vigorous country squire, who prided himself on the absence of all taints of hereditary disease in the ancestors of his wife or of himself. He often forewarned his son not to be the one to introduce disease into the pure blood which he inherited. To this advice he wisely added something more sure of obtaining the desired end—a judicious education and breeding.

The boy was trained in all healthful and invigorating country pursuits—walking, riding, rowing, climbing, and the like; while his intellectual development was watched over in his father's house, first by his mother, and afterwards by a well-chosen tutor. His habits of life were not those of eccentric abstemiousness and rigour, neither were they in any way permitted to run into excesses. Great care was taken, not only that he should not have injurious companions, but, especially, that he should not live without companions. He was associated with the largest number of boys and girls of the desired class that the neighbourhood could supply, so that he might feel himself in the midst of the world, and be saved from the curse of that morbid disposition which a too solitary contemplation of self is almost sure to produce.

The tastes and habits of the boy continued with the man; activity of body and mind; participation in the interests and pursuits of those around him; generous but moderate living—free alike from excess and from a mean anchoritic attention to the details of mere animal

existence; cheerful, straightforward, simple, in every thing; such were the leading characteristics of the life now passed away.

It is not to be supposed, however, that eighty-two years could pass without a certain number of accidents and attacks of disease. He had suffered in childhood from all the usual diseases; and when about twelve years old, he had also, a severe attack of small-pox, which was then epidemic in the place where he lived. On one occasion, he had some inflammatory affection in the chest, due to a cold caught on a boating excursion in which he fell overboard. In later life, while hunting, he sustained a compound dislocation of the ankle; and he had, at different times, come in for his share of other ailments arising from contagion, the effects of cold, and the other unavoidable exigencies of a long life in this world. Nevertheless, we find him at the close, free from disease or the vestige of disease, dying simply from decay, having reached his ultimatum. This is the interest of his case to us; it illustrates the fact I have insisted upon, that there is within the organism itself, a force competent to repair injuries, and to dispose of disease under *favourable circumstances*. And we may turn to the simple story of this old man's life, in answer to the often repeated question, What are these favourable circumstances?

The next visit is to a child with measles of a very unfavourable type, complicated with asthenic pneumonia. The house is situated in an airy square, with nothing in its sanitary relations to account for the serious form the disease has assumed. The contagion was received from a little country cousin, full of health, who has lately been on a visit to town; and, shortly after arriving, sickened with measles in this very house, and there passed through the complaint in a well-developed but most benignant form; so easily did it pass off, indeed, leaving no injury

to health, that no apprehension was felt by the parents of the little town child, when the disease appeared in him. But it is now the seventh day from the appearance of the eruption, and it still lingers in livid mottlings over the surface, while the breathing powers are diminishing and the strength rapidly failing; everything combines to warrant a most gloomy prognosis. The point to which I wish to draw your attention is the difference between the circumstances of these two patients. In the little country cousin the circumstances were completely favourable; there were no germs or vestiges of disease. In the town child the circumstances were unfavourable. The conditions of life during the illness were the same in both cases; but a few weeks before the setting in of measles, I happened to see the town child, and he was then in a state of health corresponding very closely with that of the little girl we saw third among our morning patients to-day, and of whom we diagnosed that she was drifting into rickets; the germs and vestiges of disease were both rife within him.

On entering the apartment of the next patient, we find a man of fifty years, pale and œdematous in the face, with livid lips slightly parted, sitting forward in an easy chair, supporting his arms upon those of the chair. The seams of his trowsers are slit up to allow room for his swollen legs, which he keeps wide apart, and between which a spitting pot is placed on the floor. His attention is completely engrossed by the operation of breathing, which he performs very hurriedly; while, from time to time, he gives a stifled cough and expectorates some sanguinolent froth into the pot.

We have not seen the patient before; but the familiar aspect of the case suggests at once its probable history and diagnosis. He cannot answer many questions, or bear much examination; but we discover, by a hurried

auscultation, that he has serious valvular disease; that there is œdema of the lower part of each lung, and encroaching pericardial effusion. We learn from his medical attendant, that the urine is charged with albumen, and exhibits under the microscope casts both of the granular and waxy character.

He is a retired baker, who worked hard for many years at his trade; has always lived a careful abstemious life. With the exception of occasional eruptions on the skin and some dyspeptic troubles, he always thought his health good, until thirteen years ago, when he had pleurisy. This was followed in about a year by a severe attack of rheumatic fever. Since then, he has repeatedly had bronchitis, and during the last two years has several times had œdema of the integuments; and he has been gradually failing, more and more, in health. These symptoms forced him to give up business, to seek change of air, and continually to resort to medical treatment. From these means, he only received temporary benefit, his troubles returning upon him with increasing severity, and in this last attack they have resisted all treatment, and gradually overwhelmed him.

We can do but little for him now; but the case is replete with instruction. We see, in the brief record of his case, a series of the ordinary ailments of every-day life, all connected together in one continuous chain, in which the vestiges of one disease have become the germs of the next, and the vestiges of this the germs again of a third; so that we might go back to a time in this man's history when he might have been represented by the first patient whom we saw this morning—the young man saturated with rheumatic poison, but free from organic disease. And we may ask ourselves the question, whether, in that stage, means might not have been employed, and precautions insisted upon, which would have prevented the occurrence of the catalogue of diseases which have gradually brought the sufferer to a premature grave.

Having thus lightly sketched a few cases, as they occur heterogeneously in practice, to *indicate the light* in which I propose to place disease before you, I need not take you further on my round. For the economy of time, I must proceed in a more concise and systematic manner. I must endeavour to show you how intimately diseases are connected together, how they are dependent one upon the other; what numerous and diversified effects may spring from one general cause; how simple and apparently trivial may be the first germs, how important the vestiges of the diseases which spring therefrom; how these vestiges assume the place of germs to lead again to fresh diseases and fresh vestiges, until the forms which are assumed lead the physician far away from the appropriate ideas, as to the real nature of the present disease.

I shall, then, endeavour to show you, that it is to this class of changes, to these vestiges, and vestiges of vestiges, together with the *conditions of life*, that we have to look for the *real causes of mortality in disease*—to them that we have to look for the answer to the question — Why does one man die and another man recover from the same disease?

I mentioned to you before, that the conclusions which I have placed before you in the first and second Lectures, were first suggested by the facts observed in the course of daily practice. They have since been submitted to a more rigid scientific examination. The facts have been assembled and compared with other facts, in order to ascertain how far they harmonize, and whether they can be included under general laws; and, finally, their explanation has been attempted by the hypotheses which I have submitted to you.

We come now to some of the facts themselves; and it will be my duty to show you that these facts, which are familiar to you all in the phenomena and history of disease, will easily and naturally submit to be arranged

under headings dictated by the principal conclusions which I have proposed for your acceptance.

You will recollect that at the end of the second Lecture, I ventured to assume that I had established the following proposition :—

That the effects of injury or disease, and the manifestation of the V.M.F., in protecting, restoring, or repairing the organism, depend upon the relation which exists at the time between the following conditions :—

a. The position of the animal and of the part affected, at the time, with respect to the attainment of the ultimatum.

β. The state of the part affected and of all correlated parts.

γ. The state of the *conditions of life* at the time.

δ. The quantitative and qualitative state of the V.M.F.

The first of these conditions (the position with respect to the ultimatum) is full of interest. It includes the influence of age and sex, on the causation and fatality of disease. But its consideration would necessarily occupy much time, and would lead us far away from the immediate subject of these Lectures, viz., THE GERMS AND VESTIGES OF DISEASE. I shall, therefore, be obliged, with great reluctance, to omit this first condition from the analyses we are about to institute; I must refer you back to the first Lecture, in which the "law for the attainment of the ultimatum" was discussed; and leave you to make its practical application to disease, at your leisure, should you feel disposed.

The fourth condition (the state of the V.M.F.) will occupy a very important position in our analysis; and I will therefore remind you of the several conclusions at which we arrived concerning it. They were as follows :—

1. The V.M.F. may be altered in the attributes of quantity and quality by numerous causes.

2. These causes may affect either the existing individual, a succeeding generation, or both.

3. The principal of these causes are :—

a. The Conditions of Life.

b. Coetaneous diseases (that is, diseases existing at the same time with the one under consideration.)

c. The vestiges of pre-existing diseases.

I must ask you to observe, that I particularly state these as the *principal,* not as the only causes by which the V.M.F. may be altered ; they are those which relate to our present subject.

Through the influence of these several conditions, then, singly or combined, the V.M.F. may be brought to various degrees of *defectiveness.* Thus, in one case it may be only so defective as to lose the power to protect the organism against the invasion of disease, and yet be competent, *ceteris paribus,* to bring that disease to a favourable termination. In another case, it may be powerless to prevent either the invasion of disease, or its termination in death. In the first case, defect of the V.M.F., will be a *predisposing antecedent* to disease, in the individual; in the second case it will be a *cause of fatality.*

In the analyses which I am about to institute, we shall continually want some simple and concise name to represent that influence or agent which invariably precedes a disease, and without which that disease is never known to take place. The most typical example of such an influence is seen in the virus of smallpox, the poison of ague, the infection of measles or of influenza. This has been variously described as the "morbid influence," the "general cause," the "immediate cause," the "essential cause," etc., etc. But I do not know any term that so plainly expresses the sense, and no more than the sense we desire, as the two words—*Essential Antecedent.* And, therefore, for want of a better name, I shall employ this or its

initial letters (E.A.), in all the examples of disease I am about to present to your consideration.

To proceed then. In a certain number of cases it will happen, that without any defect in the V.M.F., the Essential Antecedent to the disease will be in excess of any possible condition of the V.M.F., either to protect against the invasion of disease, or to prevent death. For example, the Essential Antecedent of typhus may be so large in quantity and intense in quality as to completely overwhelm a healthy person, just as any ordinary poison may produce death, in spite of all antidotes and precautions, by being administered in a dose sufficiently overwhelming. These exceptional cases of comparative, but not actual, defect of V.M.F., must be remembered and not confounded with the actual defects with which we are here especially concerned.

The principal causes *of fatality in disease*, as dependent upon the conditions of life, coetaneous diseases, and the vestiges of disease, arrange themselves under two divisions or headings.

A. Excessive defect in the V.M.F., compared with the quantity and quality of the Essential Antecedent. Thus a person of exhausted vital powers succumbs to an ordinary attack of continued fever.

B. Excessive defect of some part of the organism (independent of its influence on the condition of the V.M.F.), at which part, therefore, it may give way; as in physics, an otherwise perfect machine may break down at some defective point, because it is "no stronger than its weakest part." Thus a person may suffer from cerebral congestion, which his V.M.F., is quite competent to rectify; but happening to have degeneration in the coats of one of the vessels concerned, which disqualifies it for sustaining the increased pressure of blood, his organism may give way at this, his weakest point, and an otherwise remediable condition may thus be rendered fatal.

For the purpose of testing the views I am putting forth, I have submitted most diseases to analysis; and it was my original intention to bring forward all these analyses in a systematic work on medicine. It is evident that this cannot be done in these lectures, nor is it at all necessary to occupy your time and try your patience by submitting any number of these analyses to your notice. Every purpose of illustration will, I think, be answered by selecting a few out of the vast number of diseases, as examples of the rest. In doing this I have felt it necessary to choose such as have a place in the Registrar's reports, and to adopt the headings there employed; because we are dependent upon them for the numerical details of any large number of deaths. But it is evident that considerable complication must be introduced into the analyses by the rough generalization unavoidable in the headings of such reports.

In the Registrar-General's report of the Deaths in London, registered in the twenty-first week of each of the ten years 1848—57 (which, I should observe, was only used because it happened to be the report current at the time of making my notes), 227·2 deaths per week are included under the following headings :—

Typhus (typhoid and other forms of continued fever included by the Registrar under this head) . .		42·2
Heart-disease	31·9	33·5
Pericarditis	1·6	
Apoplexy	26·0	49·7
Paralysis	23·7	
Bronchitis		64·5
Atrophy and debility .	26.3	29·8
Want of breast milk. .	3·5	
Rheumatism	5·8	7·5
Gout	1·7	
		227·2 per week.

I have selected these, because they each represent a

large number of deaths, and because they afford examples —of the acute specific diseases;—of local diseases, affecting several of the most important organs of the body;— of blood diseases, dependent upon causes generated within the organism; — and of defects in the nutritive processes, dependent upon a variety of causes having their origin both within and without the organism. However awkward to deal with, from the comprehensiveness of the headings, they are, I think, as fair examples as we can choose.

The leading features in the etiology of these diseases shall be enumerated under the following heads:—

1. The Essential Antecedent of the Disease.
2. The causes of the Essential Antecedent.
   These will be enumerated under the three sub-headings—
   - *a* Conditions of Life.
   - *b* Coetaneous Diseases.
   - *c* Vestiges of Disease.
3. The Predisposing Antecedents of the Disease, or those conditions which determine the selection of the individual to be attacked.
4. The causes of these Predisposing Antecedents.
   Enumerated under the three sub-headings—
   - *a* Conditions of Life.
   - *b* Coetaneous Diseases.
   - *c* Vestiges of Disease.
5. The Causes of Fatality in those cases which terminate in death.
6. The causes of these Causes of Fatality.
   Enumerated under the three sub-headings—
   - *a* Conditions of Life.
   - *b* Coetaneous Diseases.
   - *c* Vestiges of Disease.
7. The Vestiges which may remain from the Disease under consideration, when *it does not terminate in death.*

When this arrangement has been applied to the several diseases which we have taken for examples, I shall analyse them all again, in order to ascertain and to point out to you to what extent the vestiges of *each* may become *the essential antecedents, the predisposing antecedents*, or the *causes of fatality in the rest.* I shall thus endeavour to fulfil my promise, and show you, by impartial examples, how intimately diseases are connected together, how the vestiges of one disease become the germs of others, and how powerful are these vestiges as causes of Death.

END OF LECTURE III.

LECTURE IV.

Recapitulation—Etiological Analysis of Typhus, Typhoid, and other forms of continued fever, Apoplexy, Paralysis, Heart-disease, Pericarditis, Rheumatism, Gout, Bronchitis, Atrophy, Debility—The Interdependence of Diseases — Tabular Arrangement of Vestiges and their Consequences.

In our last Lecture, Gentlemen, I attempted to prepare you for the light in which I am about to present disease to your consideration. I gave you sketches of several diseases, very much as they come before us in an average day's practice. I described the case of a young man surcharged with the poison of rheumatism, and suffering from the long list of discomforts usually associated with such a state, but free as yet from organic disease. I then described a patient in later life, suffering from several well-developed diseases, traceable to neglect of a state of health dependent on the poison of gout; and I showed you, in the case of a man dying of dropsy, the last scene in a long list of disasters, due to causes similar to those which affected the first patient. I then drew the picture of a little child and its mother, the one drifting into rickets, entailed upon it by its exhausted and anæmiated parent; the other still advancing further into disease through neglect of the conditions of life, and of the vestiges of a former state of low health; in both we might see examples of those *unfavourable circumstances* under which

the V.M.F. has so frequently to be manifested during the works of repair, reproduction, and protection of the organism. And in another little child, sinking with measles and pneumonia, we saw an instance of the fatal type which the simplest diseases may be expected to acquire under such unfavourable circumstances.

In another case, I pointed out one of those obscure conditions of low health, which, as I have stated, are so intimately connected with the definitely-marked diseases with which we are all familiar.

Then I gave you a sketch of a chronic disease, of some thirty years' standing, which owed its intractability to a simple morbid influence in the constitution of the patient —long overlooked and neglected—which had been working other changes in the organism, the vestiges of which were discovered, in addition to the chronic disease for which he sought relief; all of which might have been prevented by precautions directed to the morbid influence, which was their common cause.

In the same manner, we saw the vestiges of malarious poisoning operating as a cause of disease, in the neuralgia of the lady who resorted annually to an ague district for the benefit of her health.

Lastly, I laid before you the brief record of a life in which the V.M.F. had been, throughout, manifested under circumstances which might be considered *completely favourable*, and therefore had been perfect.

To-day, Gentlemen, I have to submit to you in a more systematic way, an analysis of the natural history of several of those states of disease assembled under certain names in the Registrar-General's reports of the deaths in London.

The principal facts in the etiology of these diseases, I have arranged under certain headings, dictated by the conclusions at which we have arrived in the previous Lectures. These headings were enumerated in the last

Lecture. What I wish especially to make clear to you by this arrangement, is the influence of THE CONDITIONS OF LIFE and of THE VESTIGES OF DISEASE in producing *the essential antecedents of disease,* the *predisposing antecedents of disease,* and the *causes of fatality in disease.* I wish you to see how many of the most important phenomena of disease, and of the most important facts in its natural history, arrange themselves naturally under the three classes, *conditions of life, coetaneous diseases,* and the *vestiges of disease.*

I. TYPHUS FEVER (TYPHOID AND OTHER FORMS OF CONTINUED FEVER, See p. 68).

THE ESSENTIAL ANTECEDENT (OR E.A.).

A poison in the organism either arising in the individual attacked or communicated from another.

CAUSES OF THE ESSENTIAL ANTECEDENT.

1. *Conditions of Life.*—Overcrowding; destitution; imperfect ventilation; exposure to emanations from decaying organic matter; organic impurities in drinking-water; and other defects in the conditions of life.
2. *Coetaneous Diseases.*—Nil.
3. *Vestiges of Disease.*—Nil.

PREDISPOSING ANTECEDENT.

Defect in the V.M.F. compared with the quantity and quality of the Essential Antecedent to which the individual is exposed.

CAUSES OF THIS PREDISPOSING ANTECEDENT.

1. *Conditions of Life.*—Those defects in the conditions of life, capable of producing the Essential Antecedent, by

exposure to which the V.M.F. becomes defective and loses its protective power; also, hunger; thirst; cold; overtax of the nervous system; physical fatigue; moral suffering; and the like; recency of residence in the conditions producing the E.A. of *typhoid.*

2. *Coetaneous Diseases.*—The existence of any disease by which the V.M.F. is rendered defective.

3. *Vestiges of Disease.*—Debility, due to imperfect convalescence from any other acute or chronic disease; disturbed correlation of organs damaged by pre-existent diseases.

CAUSES OF FATALITY.—A.

Excessive defect in the V.M.F., compared with the quantity and quality of the essential antecedent.

CAUSES OF THIS CAUSE OF FATALITY.

NOTE.—The Essential Antecedent may be in excess of any possible condition of the V.M.F. This is an occasional cause.

1. *Conditions of Life.*—Excessive defects in the conditions of life, especially such defects as are capable of originating the Essential Antecedent; atmospheric changes; and the like; recency of residence in the conditions producing the E.A. of *typhoid.*

2. *Coetaneous Diseases.* — Congestions, inflammations, etc., in the brain, intestines, lungs, etc. (for the most part dependent on the E.A. of the fever); also (substantive) pleurisy; bronchitis; inflammatory affections of the heart, lungs, brain, or intestinal mucous membrane; etc.

3. *Vestiges of Disease.*—Debility, or altered blood, due to imperfect convalescence from any acute or chronic disease; heart-disease; fatty and other degenerations.

NOTE.—The fatality of *typhus* is most influenced by the volume and intensity of the E.A. and defective V.M.F. The fatality of *typhoid* is most influenced by the conjoined effects of the E.A. and the vestiges of disease on the intestinal glands.

CAUSE OF FATALITY.—B.

Excessive defect of some part of the organism (independent of the influence of such defect on the quantity or quality of the V.M.F.)

CAUSES OF THIS CAUSE OF FATALITY.

1. *Coetaneous Diseases.*—Ulceration of the intestines; diarrhœa; hæmorrhage; peritonitis; (for the most part dependent on the E.A. of the fever).

2. *Vestiges of Disease.*—Tuberculous deposits in the lungs, glands, brain, etc.; and the like.

VESTIGES OF TYPHUS, TYPHOID, ETC.

When continued fever has not terminated in death, the following vestiges may remain.

1. Imperfect convalescence, during which the V.M.F. is defective, and a general predisposition to other diseases exists. 2. Tendency to extravasations of blood. 3. Softening of parenchymatous organs and of the tissues generally. 4. Enlarged spleen, mesenteric glands, etc. 5. Typhoid deposits in mesenteric glands, spleen, lungs, kidneys, etc. 6. Tendency to fatty degeneration. 7. Increased irritability of the nervous system. 8. Defective mental powers.

II. APOPLEXY AND PARALYSIS.

THE ESSENTIAL ANTECEDENT (OR E.A.).

May be *Toxic*, from poison in the organism; *Mechanical*, from pressure; *Degenerative*, from deficient supply of blood, and from defects in the nutritive processes.

By one or more of these causes an arrest, permanent or temporary, may take place in one or more of the functions of some part or parts of the cerebro-spinal system, and apoplexy or paralysis result.

CAUSES OF THE ESSENTIAL ANTECEDENT.

1. *Conditions of Life.*—Intemperate habits; exposure to vicissitudes of temperature; errors in diet; violent indulgence of the passions; sudden and violent emotion; mental shocks; undue excitement of the imagination; exposure to poisons, as, for example, lead.

2. *Coetaneous Diseases.*—Chronic bronchitis; Bright's disease; rheumatism and gout; strumous disease of the bones.

3. *Vestiges of Disease.*—Vestiges of chronic bronchitis, and of valvular disease of the heart; of Bright's disease in the form of uræmia and degenerated arteries; of disease of the blood, arteries, and heart, in the form of masses of fibrine floated into cerebral vessels; of rheumatism and gout, in the form of valvular disease of the heart and degeneration of arteries; of syphilis.

PREDISPOSING ANTECEDENTS.

A. Defect in the V.M.F.

B. Excessive defect in some part of the organism.

CAUSES OF THESE PREDISPOSING ANTECEDENTS.

1. *Conditions of Life.*—Certain trades and professions; the coexistence in the same individual of several of the causes of the Essential Antecedent, or the existence of any one in an excessive degree.

2. *Coetaneous Diseases.*—Those enumerated as causes of the Essential Antecedent.

3. *Vestiges of Disease.*—Of a former attack of apoplexy or paralysis; of diseases of the arteries, heart, or blood, in the form of fibrinous vegetations on the endocardium, and fibrinous masses in the heart or loose in the torrent of the circulation; those vestiges of disease enumerated as causes of the Essential Antecedent, may rank as causes of the predisposing antecedents unless or until they produce the disease.

Age above fifty is always said to be a strong predisposing cause of apoplexy and paralysis; but it is so, chiefly because that period of life is the most subject to those vestiges of disease and conditions of life, already stated, which act as causes of the Essential and Predisposing Antecedents of apoplexy and paralysis.

CAUSE OF FATALITY.—A.

Excessive defect in the V.M.F., compared with the quantity and quality of the Essential Antecedent.

CAUSES OF THIS CAUSE OF FATALITY.

1. *Conditions of Life.*—The persistence of those conditions of life, enumerated as causes of the Essential Antecedent; this is especially the case, when the organism has been already damaged by one or more attacks of apoplexy or paralysis. Defects in the amount of exercise, and in the supply of food, warmth, and the other comforts of life, especially tend to render *paralysis* fatal.

2. *Coetaneous Diseases.*—The acute specific diseases; any acute disease of the organs of circulation, or of the nervous system.

3. *Vestiges of Disease.*—In *apoplexy*, the existence in an excessive degree of those vestiges enumerated as causes of the essential antecedent, especially the coexistence of such in various parts of the organism; the vestiges of former attacks of apoplexy. In *paralysis*, the same as in apoplexy, and, also, vestiges of former diseases in the genito-urinary organs, and of any severe illness, in the form of protracted, imperfect, convalescence.

CAUSE OF FATALITY.—B.

Excessive defect of some part of the organism (independent of the influence of such defect on the quantity or quality of the V.M.F.).

NOTE.—This is the most usual cause of fatality in apoplexy.

CAUSES OF THIS CAUSE OF FATALITY.

These causes are almost confined to the one heading, Vestiges of Disease.

They are chiefly, excessive degeneration of the cerebral or spinal vessels, and especially when these occupy certain positions; pressure due to destruction of vertebræ in certain important situations; excessive defect in the kidney in uræmic apoplexy; excessive defect in the heart or lungs.

VESTIGES OF APOPLEXY AND PARALYSIS.

When apoplexy and paralysis have not terminated in death, the following vestiges may remain :—

From Apoplexy.—1. Paralysis of sensibility, of motion, or of both. 2. A condition in which a return of the disease is imminent, and that in a more severe form. 3. Softening of some part of the brain. 4. Impaired intellect.

From Paralysis.—1. Softening of some part of the brain, or spinal cord. 2. A condition in which a return of the disease in a more severe form, or of apoplexy, is strongly invited. 3. Impaired intellect. 4. Diseases of the genito-urinary organs. 5. Tendency to mortification in the paralysed parts. 6. Degeneration of the paralysed parts or of the organism generally. 7. Tendency to death in any attack of chronic or acute disease.

III. HEART-DISEASE AND PERICARDITIS.

THE ESSENTIAL ANTECEDENT (OR E.A.).

May be *Toxic*, from some poison in the blood; *Mechanical*, from undue stress put upon some part or parts of the organ, or upon the entire organ; *Degenerative*, from some defect in the nutritive processes, either of the whole organism, or of the organ itself.

CAUSES OF THE TOXIC E.A.

1. *Conditions of Life.*—Intemperate habits; vicissitudes of temperature; meteorological changes; errors in diet; and those other conditions of life which act as causes of the following coetaneous diseases.

2. *Coetaneous Diseases.*—Scarlet fever; rheumatic and gouty assimilation, or whatever that diseased condition may be which generates the poisons of rheumatism and gout.

3. *Vestiges of Disease.*—Of Bright's disease; of severe chills to the surface of the body; of rheumatism and gout in an ancestor.

CAUSES OF THE MECHANICAL E.A.

1. *Conditions of Life.*—Pursuits calling for violent exertions of physical force, especially if associated with frequent ascents; also pursuits requiring frequent rapid ascents without violent exercise; frequent violent excitement to the passions or emotions.

2. *Coetaneous Diseases.*—Bronchitis; spasmodic asthma; emphysema (generally a vestige of some other disease.)

3. *Vestiges of Disease.*—Vestiges of the toxic influence of rheumatism, gout, scarlet fever, Bright's disease, in the form of valvular disease, adherent pericardium, altered blood, etc.; degeneration of the arterial coats, by which they lose their elasticity; of bronchitis, in the form of retrograde venous congestion, obstructed respiration from thickened tubes, emphysema, and bronchiectasis; of spasmodic asthma, in the form of obstructed circulation through the chest.

CAUSES OF THE DEGENERATIVE E.A.

1. *Conditions of Life.*—Intemperate habits; sedentary habits; persistent defect in the quantity or quality of food; habitual residence in a super-carbonized or insufficiently oxygenated atmosphere; sudden change, *afterwards*

persisted in, from long continued habits of *active* exertion, to those of comparative inactivity, either of the whole organism or of the heart only.

2. *Coetaneous Diseases.*—Those diseases of assimilation accompanied by degeneration of tissue.

3. *Vestiges of Disease.*—Of Bright's disease, both in the form of general degeneration of tissues, including the heart, and of degeneration of the heart secondary to that of the coronary vessels; of rheumatic and gouty inflammation of the heart and its investments; of any acute or chronic disease, in the form of protracted and imperfect convalescence, especially of continued fevers, puerperal fever, scrofulous affections, and paralysis; of mechanical heart-diseases, viz., hypertrophy and dilatation —consequent on the inactive life those states necessitate— in the form of impaired nutrition, which especially affects organs previously hypertrophied.

PREDISPOSING ANTECEDENTS.

A. Defect in the V.M.F.

B. Excessive defect in some part of the organism.

The *Causes of these Predisposing Antecedents* are those *Conditions of Life*, *Coetaneous Diseases*, and *Vestiges of Disease*, including diatheses hereditary or acquired, which have been enumerated as causes of the different forms of essential antecedents. They need not be recapitulated.

CAUSE OF FATALITY.—A.

Excessive defect of the V.M.F., compared with the quantity and quality of the essential antecedent.

CAUSES OF THIS CAUSE OF FATALITY.

NOTE.—The Essential Antecedent may be in excess of any possible condition of the V.M.F.

1. *Conditions of Life.*—The continuance, after the pro-

duction of the disease, of excessive exposure to those conditions of life enumerated as causes of the essential antecedents; deficiency of the comforts of life in those previously accustomed to them, or any sudden and marked change from those conditions of life which have been found most conducive to the patient's health in his damaged state.

2. *Coetaneous Diseases.*—The simultaneous occurrence, in an excessive degree, of heart-disease, due to two or more of the forms of the essential antecedent, toxic, mechanical, degenerative; a severe attack of the acute specific diseases; spasmodic asthma, in a severe paroxysm; diabetes; bronchitis; pneumonia; pleurisy; angina pectoris; severe hæmorrhage, uterine, and the like.

3. *Vestiges of Disease.*—Excessive debility, a vestige of any acute or chronic disease; vestiges of repeated attacks of bronchitis, in the form of impeded respiration and circulation, and defective blood; of pleurisy, in the form of extreme effusion and its consequences.

CAUSE OF FATALITY.—B.

Excessive defect in some part of the organism (independent of the influence of such defect on the quantity or quality of the V.M.F.).

CAUSES OF THIS CAUSE OF FATALITY.

1. *Coetaneous Diseases.*—Disease of the liver, stomach, or spleen, in consequence of which the congestion due to the heart-disease may lead to fatal ascites, or to fatal hæmorrhage from the stomach; phthisis pulmonalis, in consequence of which the pulmonary congestion due to heart-disease may lead to fatal hæmoptysis; in degenerated heart, the coexistence of hæmorrhage from any organ may prove fatal by syncope.

2. *Vestiges of Disease.*—Degeneration of a portion of the cardiac walls may lead to rupture, from the stress

thrown upon the weakened part by disease of another part or of the rest of the organ; an aneurism may be ruptured by the force of a hypertrophied heart; degenerated cerebral vessels may be ruptured by the congestion consequent on disease of the heart; pericarditis with effusion may be rendered fatal by a previously dilated or degenerated heart; and the like.

VESTIGES OF DISEASE OF THE HEART AND PERICARDIUM.

When diseases of the heart have not terminated in death, the following vestiges may remain.

Of the Toxic.—1. Adhesions, thickenings, or effusions in the pericardium. 2. Constriction or insufficiency of the valves of the heart. 3. Tendency to degeneration of the muscular tissue of the heart. 4. Chorea in its worst forms.

Of the Mechanical.—1. Dilatation or hypertrophy of the heart. 2. Venous congestion of all parts in arrear of the obstruction in the heart, constituting a predisposing antecedent in all those parts to inflammations, hæmorrhages, and fluxes, and producing hardening of parenchymatous organs. 3. Obstruction to the systemic circulation. 4. Disease of the kidneys from continual congestion. 5. Dropsy.

Of the Degenerative.—1. Tendency to death from any disease, surgical operation, accident, or excitement of the passions or emotions. 2. Angina pectoris. 3. Inclination to syncope on sudden movements. 4. Dropsy.

IV. RHEUMATISM AND GOUT.

THE ESSENTIAL ANTECEDENT (OR E.A.).

A poison in the organism (probably uric or lactic acid).

CAUSES OF THE ESSENTIAL ANTECEDENT.

1. *Conditions of Life.*—Intemperate habits; errors in

the quantity or quality of food; exposure to vicissitudes of temperature; confinement to ill-ventilated dwellings; sedentary habits; neglect of the condition of the skin, and consequent defect in the cutaneous secretion; certain meteorological conditions; deficient supply of water to the organism. There is usually a concurrence of several of these conditions.

2. *Coetaneous Diseases.*—Certain forms of disease in the digestive and assimilating organs; the desquamative stage of scarlet fever; Bright's disease.

3. *Vestiges of Disease.*—Vestiges of rheumatism or gout in an ancestor; vestiges of scarlet fever.

PREDISPOSING ANTECEDENTS.

A. Defect in the V.M.F.

B. Excessive defect in some part of the organism.

CAUSES OF THESE PREDISPOSING ANTECEDENTS.

1. *Conditions of Life.* — Superlactation; inordinate sexual indulgence; the depression of fear, grief, melancholy, and the like; the concurrence of several of the conditions of life enumerated as causes of the E.A., dispose to the occurrence of the disease on the addition of the rest. An attack of rheumatic or gouty inflammation or pain, is invited by any circumstances which, for the time, either suddenly render the V.M.F. defective, or suddenly increase the quantity of the Essential Antecedent.

2. *Coetaneous Diseases.*—Disease in any organ, whose function it is to excrete materials convertible into the Essential Antecedent, as the skin and kidneys.

3. *Vestiges of Disease.*—Of rheumatism or gout in an ancestor; of acute or chronic diseases, especially scarlet fever and influenza, in the form of debility and poisoned blood.

CAUSE OF FATALITY.—A.

Excessive defect in the V.M.F. compared with the quantity and quality of the essential antecedent.

CAUSES OF THIS CAUSE OF FATALITY.

NOTE.—In very rare cases the Essential Antecedent is in excess of any possible condition of the V.M.F.

Conditions of Life.—Persistence, after the existence of the disease, of the conditions enumerated as causes of the essential antecedent, or an excessive accumulation of them; sudden change, in a person affected with the disease, from habits of luxury to those of penury and want.

Coetaneous Diseases.—Pneumonia; bronchitis; apoplexy. Rheumatism and gout are often fatal through the existence of pericarditis, endocarditis, meningitis, or pleuritis, due to the same cause as the rheumatism or gout, and simply indicating the extent of the influence of the essential antecedent; the coetaneous affection of these organs and parts will render the V.M.F. defective, and therefore may be mentioned here: the same may be said of gout in the stomach.

Vestiges of Disease.—Protracted convalescence, a vestige of any acute or chronic disease; vestiges of the long continuance of the essential antecedent in the organism, as, for example, anæmia and nervous exhaustion; vestiges of former attacks of rheumatic or gouty inflammation in the endocardium, pericardium, pleura, or stomach, by which the normal correlation of parts is disturbed.

CAUSE OF FATALITY.—B.

Excessive defect of some part of the organism (independent of the influence of such defect on the V.M.F.).

CAUSES OF THIS CAUSE OF FATALITY.

Vestiges of Disease.—Dilatation and degeneration of the heart; disorganisation of the kidneys, a vestige of Bright's disease; vestiges of dysentery, in the form of ulcers of the intestines; severe valvular disease, a vestige of former attacks of rheumatism or gout.

VESTIGES OF RHEUMATISM AND GOUT.

When the Essential Antecedent of rheumatism or gout has long existed in the organism without an acute attack of rheumatic or gouty inflammation having occurred, the following vestiges may remain :—

1. Calculus in the kidney or bladder. 2. Fatty and calcareous degenerations or deposits in the walls of the heart or of arteries. 3. Degeneration of the tissues generally. 4. Stiffened and contracted joints. 5. Cutaneous affections. 6. Cataract. 7. Debility, especially in the character of anæmia. 8. A rheumatic or gouty constitution transmitted to a future generation.

NOTE.—The host of functional disturbances, consequent upon the presence of the Essential Antecedent, are not properly *vestiges*, but symptoms of the presence of the Essential Antecedent.

When one or more attacks of *rheumatic fever* have not terminated in death, the following vestiges may remain :—

1. Valvular disease. 2. Pericardial adhesions. 3. Pericardial effusion. 4. Pleuritic adhesions and effusions. 5. Stiffened joints. 6. Fatty degeneration of the heart. 7. Anæmia. 8. Debility and nervous exhaustion. 9. Tendency to a repetition of the attack, and of its determination to the damaged parts. 10. The rheumatic constitution transmitted to a future generation.

When one or more attacks of *gout* have not terminated in death, the following vestiges may remain :—

1. Deposits of urate of soda in and about joints, and in some other parts of the organism. 2. Tendency to a return of the attack. 3. Debility and anæmia. 4. If the gouty inflammation attacked the stomach, a very sensitive and dyspeptic state of stomach may remain. 5. A gouty constitution transmitted to a future generation.

V. BRONCHITIS.

THE ESSENTIAL ANTECEDENT.

A toxic or an irritant influence exerted upon the lining membrane of the bronchi and their ramifications, by which inflammation is set up.

CAUSES OF THE ESSENTIAL ANTECEDENT.

1. *Conditions of Life.*—Sudden transitions of temperature; certain peculiar meteorological conditions; exposure to mechanical and chemical irritants in the atmosphere, as in certain trades; etc.

2. *Coetaneous Diseases.*—Measles; influenza; catarrh; whooping cough.

PREDISPOSING ANTECEDENTS.

A. Defect in the V.M.F.

B. Excessive defect in some part of the organism.

CAUSES OF THESE PREDISPOSING ANTECEDENTS.

1. *Conditions of Life.*—Overcrowded, overheated, ill-ventilated dwellings; certain meteorological conditions; intemperate habits; certain trades.

2. *Coetaneous Diseases.*—The presence in the organism of the Essential Antecedent of typhus, typhoid-fever,

scarlet-fever, small-pox, syphilis; Bright's disease; tuberculosis; some diseases of the liver.

3. *Vestiges of Disease.*—Vestiges of former attacks of bronchitis in the forms enumerated further on. Vestiges of spasmodic asthma; valvular disease of the heart; hypertrophy and dilatation of the heart; fatty degeneration of the heart; congenital syphilis, a vestige of syphilis in an ancestor; acquired syphilis, a vestige of the primary disease; vestiges of Bright's disease.

CAUSE OF FATALITY.—A.

Excessive defect in the V.M.F. compared with the quantity and quality of the Essential Antecedent.

NOTE.—It is possible for the Essential Antecedent to be in excess of any possible condition of the V.M.F. But this is not a probable cause; for death from the direct effect of a first attack of bronchitis in a previously healthy person, is, to say the least, excessively rare.

CAUSES OF THIS CAUSE OF FATALITY.

1. *Conditions of Life.*—Defects, either of quantity or quality, in the supply of food, heat, or air; excessive defect in any of those conditions of life enumerated as causes of the predisposing antecedents; persistence of one or many of the causes of the E.A.; superlactation.

2. *Coetaneous Diseases.*—One or more of any acute diseases, especially those dependent upon morbid poisons; spasmodic asthma; some diseases of the liver; rickets; pneumonia; whooping-cough; purpura; tuberculosis; scrofulosis; pericarditis; endocarditis.

3. *Vestiges of Disease.*—Imperfect convalescence from any acute or chronic disease, in the form of debility; morbid blood, a vestige of Bright's disease; vestiges of bronchitis, in the forms enumerated further on; diseases of the heart; vestiges of gout, rheumatism, and influenza

etc.; vestiges of syphilis in the present or in a former generation; of pleurisy and pneumonia in the form of effusions, adhesions, consolidations, and consequent diminution of respiratory capacity; of whooping-cough; of apoplexy, in the cachexia due to paralysis of locomotive organs; of rheumatic and gouty habits, in the form of anæmia and debility in a parent; vestiges of disease, in the form of rickets in a child; of tuberculosis; etc. etc.

CAUSE OF FATALITY.—B.

Excessive defect in some part of the organism (independent of the influence of such defect on the V.M.F.).

CAUSES OF THIS CAUSE OF FATALITY.

Vestiges of Disease.—Rickets, in the form of softened ribs; degenerated vessels, the vestiges of Bright's disease, gout, etc., may be ruptured by the violence of the cough; a dilated or degenerated heart may be brought to a stand-still by a fit of coughing, or by the unusual stress thrown upon it by the congested state of the bronchi; an aneurism may be ruptured by a severe fit of coughing; fatal hæmorrhage may be set up by the shock of the cough upon a tuberculous, gangrenous, or pneumonic cavity in the lungs.

VESTIGES OF BRONCHITIS.

When bronchitis has not terminated in death, the following vestiges may remain, either from the first or from repeated attacks:—

1. Chronic bronchitis, with or without bronchorrhœa. 2. Emphysema. 3. Dilated bronchi. 4. Thickened bronchial walls. 5. Hypertrophy of the heart, especially dilatation. 6. Hepatic venous congestion (of Kiernan). 7. General venous congestion. 8. Deficiently oxygenated

blood. 9. Kidney disease, secondary to the heart-disease and general venous congestion. 10. Debility. 11. Tendency to recurrence of the disease.

VI. ATROPHY AND DEBILITY.

THE ESSENTIAL ANTECEDENT.

Loss of that condition and correlation of the different parts of the organism essential to the manifestation of the V.M.F. in normal quantity and quality.

CAUSES OF THE ESSENTIAL ANTECEDENT.

1. *Conditions of Life.*—Deficient or defective supply of pure atmospheric air, heat, light, food, and occupation for the mind; excessive excitement of the depressing emotions, such as disappointment, home-sickness, deferred hope; intemperance in the indulgence of the passions, or in alcohol; superlactation; late marriage of either the individual or the parents; etc.

2. *Coetaneous Diseases.*—The various fluxes and other exhausting diseases.

3. *Vestiges of Disease.*—Of syphilis in the individual or in an ancestor, in the form of poisoned blood, or of secondary or tertiary disease in one or more organs, or the co-existence of both; of Bright's disease; of diabetes and other exhausting discharges; of hæmorrhages active or passive; of anæmia or other cachexiæ in a parent, especially in the form of rickets in the children of anæmic and cachectic mothers; of gout and rheumatism, especially when long continued in the latent form, or often repeated in the acute; of repeated or prolonged chronic bronchitis; of paralysis; of scrofula in an ancestor; of rickets, in the form of albuminoid deposits; of dilated and degenerated heart, in the form of defective circulation; of the acute specific diseases; etc., etc.

CAUSE OF FATALITY.

Excessive defect in the V.M.F.

CAUSES OF THIS CAUSE OF FATALITY.

1. *Conditions of Life.*—The persistence of one or more of those conditions of life enumerated as causes of the Essential Antecedent.

2. *Coetaneous Diseases.*—The occurrence of any additional disease in the organism already atrophied or debilitated, especially the acute specific diseases and inflammations; the persistence of several of those coetaneous diseases enumerated as causes of the E.A.

3. *Vestiges of Disease.*—The concurrence of several of those vestiges enumerated as causes of the E.A.

VESTIGES OF ATROPHY AND DEBILITY.

When atrophy and debility have not terminated in death, the following vestiges may remain:—

1. Rickets, in children produced while the mother is suffering from atrophy and debility. 2. Scrofulosis or tuberculosis, in children produced while either parent is suffering from atrophy or debility. 3. Degeneration of tissues generally, or of those of some organ or part. 4. Dilatation of the heart, especially in those who have made frequent ascents during atrophy and debility. 5. Fibrinous masses in the heart or vessels, which may float off. 6. Varicose veins. 7. Lardaceous or albuminoid deposits, especially in the liver, spleen, lymphatic glands, and kidneys. 8. Deformities in the osseous skeleton. 9. Arrest of development in certain muscles or other parts of the organism. 10. Effusions into serous cavities, and discharges from the mucous passages. 11. Tendency to become affected by any morbid influence to which the organism may be exposed (general predisposition to

disease). Tendency to death from all acute and chronic diseases, occurring during the continuance of atrophy and debility.

I shall now recapitulate the list of vestiges which we have seen may remain after the several diseases that have been analysed, and I shall point out to you the manner in which these vestiges may each of them act as the Predisposing Antecedent, the Essential Antecedent, and the Cause of Fatality, in one or more of these diseases. If I were to enumerate all the diseases that might flow from each of the vestiges mentioned, it would show the extent of their influence in a stronger light, but it would carry us far beyond the limits of this lecture.

My object, in this place, is to exhibit to you in a conspicuous manner, the interdependence of diseases. I have, therefore, restricted myself to a statement of the influence exerted by the vestiges of each of the diseases already examined upon the rest of the same little group. And I have arranged these facts in a tabular form, that you may see the different relationships at a glance.

NOTE TO TABLE OVER-LEAF.—In this Table, the first column enumerates the Vestiges of each of the Diseases we have analysed; the second, third, and fourth columns show, respectively, to which of those diseases *each vestige* may become the cause of the Predisposing Antecedents, of the Essential Antecedents, or of the Causes of Fatality. Note also, that several Vestiges usually concur in producing their effects.

INTERDEPENDENCE OF DISEASES.

See Note, p. 91.

Vestiges of Diseases of the Heart and Pericardium.	Predisposing Antecedents to—
Constriction or insufficiency of the valves. Adhesions of the pericardium	Bronchitis. Apoplexy (by inclining to fibrinous clots in the circulation). Ditto paralysis . .
Tendency to degeneration after repeated inflammations . .	Fatty degeneration of the heart .
Hypertrophy of the heart . .	Fatty degeneration of the heart .
Venous congestion of the lungs, brain, liver, and all parts in arrear of the obstruction in the heart	Bronchitis. Apoplexy . . .
Tendency to inflammations, hæmorrhages, and fluxes in the organs congested	Bronchitis. Toxic heart-disease .
Obstruction to the systemic arterial circulation, secondary to the venous congestion . . .	Bronchitis . . . . .
Dilatation and defect in the force of the systemic circulation . .	. . . . .
Tendency to death from any subsequent disease, surgical operation or accident . . .	Debility . . . . .
Angina pectoris	. . . . .
Disease of the kidneys, from continued congestion. Dropsy .	Apoplexy . . . . .

Vestiges of Bronchitis.	Predisposing Antecedents to—
Dilated bronchi	Bronchitis. . . . .
Emphysema	Bronchitis. Heart-disease . .
Hypertrophy of the heart, especially dilatation	Bronchitis. . . . .

INTERDEPENDENCE OF DISEASES.

Essential Antecedents to—	Causes of Fatality in—
Dilatation and hypertrophy of the heart	Bronchitis. Rheumatic fever.
. . . . .	Bronchitis. Rheumatic fever.
Apoplexy and paralysis . . .	Bronchitis. Heart-disease. Rheumatic fever. Typhus.
. . . . .	Rheumatic fever. Typhus.
Aggravated hypertrophy and dilatation of the heart. Apoplexy and paralysis.	Apoplexy. Bronchitis. Heart-disease. Rheumatism and gout. Typhus.
Atrophy and debility . . .	Heart-disease. Typhus.
. . . . .	All forms of heart-disease. Rheumatism and gout. Bronchitis. Apoplexy and paralysis. Typhus.
. . . . .	Bronchitis. Heart disease.
Apoplexy	Heart-disease. Bronchitis. Atrophy and debility. Typhus.

Essential Antecedents to—	Causes of Fatality in—
. . . . .	Bronchitis.
Heart-disease	Bronchitis. Atrophy and debility. Heart-disease.
. . . . .	Bronchitis. Apoplexy.

See Note, page 91.

Vestiges of Bronchitis—*continued.*	Predisposing Antecedents to—
Chronic bronchitis, (with or without bronchorrhœa)	Apoplexy . . . . .
Hepatic venous congestion (Kiernan)	Bronchitis.
General venous congestion and deficiently oxygenated blood . .	Apoplexy . . . . .
Thickened bronchial walls . .	. . . . .
Debility	Typhus. Rheumatism. Heart-disease . . . . .
Kidney-disease, secondary to other vestiges	Apoplexy. Rheumatism . . .

Vestiges of one or more attacks of Rheumatic Fever.	Predisposing Antecedents to—
Valvular disease	Bronchitis . . . . .
Pericardial effusion. Pericardial adhesions to the heart or pleura .	. . . . .
Pleuritic adhesions and effusions .	. . . . .
Stiffened joints	Atrophy and debility, degenerative heart-disease . . . .
Tendency to a repetition of the attack, and of its determination to the damaged parts . .	A repetition of an attack of gout or rheumatic fever.
Anæmia	Typhus ; heart-diseases, degenerative and mechanical . . . .
Debility and nervous exhaustion, especially from repeated attacks	Bronchitis, rheumatic and gouty attacks. Typhus . . .

Essential Antecedents to—	Causes of Fatality in—
Heart disease. Atrophy and debility.	Heart-disease. Rheumatic fever. Atrophy and debility. Bronchitis, by exhaustion from excessive discharge, or asphyxia, from accumulation of secretion.
. . . . .	Typhus. Apoplexy. Subsequent attacks of bronchitis.
. . . . .	Bronchitis.
Atrophy and debility . . .	Bronchitis. Paralysis. Any severe disease, especially typhus and others due to a morbid poison in the blood.
Apoplexy. Heart-disease . .	Heart-disease. Rheumatism and gout. Typhus. Apoplexy.

Essential Antecedents to—	Causes of Fatality in—
Apoplexy. Mechanical heart-disease.	Bronchitis. Typhus. Heart-disease. Subsequent attacks of rheumatism and gout.
. . . . .	Bronchitis. Rheumatism and gout. Typhus and heart-disease.
. . . . .	Bronchitis. Rheumatism and gout. Typhus. Heart-disease. Atrophy and debility.
Local paralysis.	
Atrophy and debility in the subject, and in the offspring, if the subject is a female	Paralysis. Bronchitis. Typhus. Heart-disease.
Dilatation and degeneration in hypertrophy of heart	Rheumatism and gout. Typhus. Heart-disease. Atrophy and debility.

See Note, page 91.

Vestiges of one or more attacks of gout.	Predisposing Antecedents to—
Deposits of urate of soda in and about joints and some other parts	Apoplexy . . . . .
Tendency to a return of the attack in the parts previously affected .	Attacks of gout.
Anæmia and nervous exhaustion, especially from repeated attacks	Bronchitis, rheumatic and gouty attacks, typhus . . . .

Vestiges of Rheumatism or Gout, when the E.A. has remained long in the organism without producing acute gouty or rheumatic inflammation.	Predisposing Antecedents to—
Fatty and calcareous degenerations or deposits in the heart, arteries, and capillaries. Degeneration of the tissues generally . . .	Apoplexy and paralysis. Bronchitis.
Chronic disease of the kidneys . .	Bronchitis . . . . .
Stiffened and contracted joints. .	Degenerative heart disease.
Cutaneous affections . . .	Attacks of gouty or rheumatic inflammations, when the skin disease is repelled.
Anæmia and other forms of debility	Degenerative and mechanical heart-disease. Bronchitis. Rheumatic and gouty attacks. Typhus .

Vestiges of Rheumatism or Gout active or latent.	Predisposing Antecedents to—
The rheumatic or gouty constitution *transmitted to a future generation*	Rheumatism, gout, and heart-disease in the generation concerned . . . . .

Essential Antecedents to—	Causes of Fatality in—
Heart-diseases.	
Atrophy and debility. Atrophy and debility in the offspring (if the subject is a female) . . .	Bronchitis. Rheumatism and gout. Typhus. Heart-disease. Atrophy and debility.

Essential Antecedents to—	Causes of Fatality in
Apoplexy and paralysis. Heart-disease (mechanical and degenerative). Atrophy and debility.	Rheumatism and gout. Apoplexy and paralysis. Bronchitis and typhus.
Apoplexy (uræmic). Heart-disease .	Paralysis. Apoplexy. Rheumatism and gout.
Atrophy and debility in the subject. Atrophy and debility in the offspring (if the subject is a female). Dilatation and degenerative hypertrophy of the heart . .	Paralysis. Bronchitis. Rheumatism and gout. Typhus. Heart-disease. Atrophy and debility.

Essential Antecedents to—	Causes of Fatality in—
Rheumatism, gout, heart-disease, and debility in the generation concerned.	

See Note, page 91.

Vestiges of Typhus, Typhoid, and other forms of Continued Fever.	Predisposing Antecedents to—
Tendency to fatty degeneration .	Debility. Degenerative heart-disease.
Great defect in the V.M.F., especially during protracted convalescence.	Bronchitis. Attacks of rheumatic or gouty inflammation. Acute specific diseases.
Increased irritability in the nervous system	Heart-disease and apoplexy, in those previously affected with other Predisposing Antecedents . .
Softening of parenchymatous organs and of the tissues generally .	. . . . .
Tendency to extravasations of blood	Apoplexy and paralysis . . .
Typhoid deposits, and enlarged mesenteric glands, spleen, etc. .	. . . . .

Vestiges of Apoplexy.	Predisposing Antecedents to—
Paralysis of sensibility or motion .	. . . . .
Strong tendency to a recurrence of apoplexy in a more severe form.	Apoplexy and paralysis.
Softening of some part of the brain .	Apoplexy . . . . .

Vestiges of Paralysis.	Predisposing Antecedents to—
Tendency to recurrence of the attack in a more severe form, or to apoplexy	Paralysis. Apoplexy.
Tendency to mortification in the paralysed parts	. . . . .
Softening of a portion of brain or spinal cord	. . . . .
Diseases of the urinary tract . .	. . . . .
Degeneration of the paralysed parts, or of the organism generally .	. . . . .
Tendency to death in an attack of acute or chronic disease . .	. . . . .

Essential Antecedents to—	Causes of Fatality in—
Degenerative heart-disease, in cases of pre-existent hypertrophy	Paralysis.
Atrophy and debility. Heart-disease	Bronchitis. Atrophy and debility. Rheumatism and gout. Heart-disease. Paralysis.
. . . . .	(When affecting the brain), apoplexy.
. . . . .	Heart-disease. Apoplexy. Bronchitis.
Atrophy and debility . . .	Any other form of continued fever.

Essential Antecedents to—	Causes of Fatality in—
Atrophy and debility, by producing fatty degeneration . . .	Bronchitis. Heart-disease. Apoplexy.
Paralysis	Typhus. Apoplexy.

Essential Antecedents to—	Causes of Fatality in—
. . . . .	Atrophy and debility. Typhus.
. . . . .	Apoplexy. Typhus.
. . . . .	Apoplexy. Paralysis. Heart disease.
Heart-disease, degenerative.	
. . . . .	Typhus. Atrophy and debility. Bronchitis. Rheumatism and gout.

See Note, page 91.

Vestiges of Atrophy and Debility.	Predisposing Antecedents to—
Rickets in children, produced while the mother is suffering from atrophy and debility.	Typhus and acute specific diseases generally
Scrofulosis or tuberculosis in the children, produced while either parent is suffering from atrophy or debility.	Paralysis (from strumous disease of vertebræ)
Degeneration of tissues generally, or of those of some organ or part	Apoplexy and paralysis, heart disease
Dilatation of the heart, especially in those who have made frequent ascents during atrophy and debility	Bronchitis
Fibrinous clots in the heart or vessels which may float off.	Apoplexy or paralysis
Lardaceous or albuminoid deposits, especially in the liver, spleen, lymphatic glands, and kidneys	Atrophy and debility
Deformities in the osseous skeleton	Atrophy and debility. Local paralysis
Arrest of development in certain muscles or other parts of the organism	
Effusions into serous cavities, and discharges from the mucous passages	
Tendency to become affected by any morbid influence to which the organism may be exposed (general predisposition to disease)	Typhus, bronchitis, heart-disease, rheumatism, and gout.
Tendency to death from all acute and chronic diseases, occurring during the continuance of atrophy or debility	

Essential Antecedents to—	Causes of Fatality in
Atrophy and debility . . .	Bronchitis. Typhus.
Atrophy and debility . . .	Bronchitis. Typhus.
Debility. Heart-disease. Apoplexy and paralysis	Apoplexy and paralysis.
Atrophy and debility from deficient circulation	Bronchitis. Typhus. Rheumatism. Apoplexy and paralysis. Heart-disease.
Apoplexy and paralysis (if clots float into the cerebral or spinal vessels.)	Apoplexy. Heart-disease. Rheumatism. Typhus. Atrophy and Debility.
Atrophy and debility . . .	Typhus.
. . . . .	Bronchitis. Heart-disease.
Atrophy and debility, local paralysis.	
Atrophy and debility . . .	Bronchitis. Heart-disease. Typhus. Rheumatism and gout.
. . . . .	Apoplexy and paralysis, bronchitis, heart-disease, typhus, rheumatism and gout. Atrophy and debility.

LECTURE V.

Recapitulation.—Vestiges of Disease in the Form of Anæmia—Subjects most liable to Anæmia—Headings under which Deaths from Anæmia are registered—Anæmia and Rickets—Rickets as a cause of Death.—Vestiges of Disease in the Form of Syphilis—Headings under which Deaths from Syphilis are registered—The Coincidence of Death and the Cause of Death.—Vestiges of Disease in the Form of Fatty Degeneration—Headings under which Deaths from Fatty Degeneration are registered.—Normal and Abnormal Physiological States—Examples of their Influence—Idiosyncrasies—Health—Degraded Health, connected with the Fluids, Excretory Organs and Nervous System, its Relation to definite Diseases—Bright's Disease, undemonstrative Invasion and Progress—Pre-organic Stage of Diseases—Propositions.

In the last Lecture, Gentlemen, I submitted to you an analysis of the natural history of several diseases, in order to show you that the principal causes of the Essential Antecedents, the Predisposing Antecedents, and the Causes of Fatality, in disease, may be classed under the three heads, Conditions of Life, Coetaneous Diseases, and the Vestiges of Disease. I then submitted to a second analysis the diseases thus examined, in order to show you the manner in which the vestiges of each may assume the place of essential antecedents, predisposing antecedents, or causes of fatality, to the other diseases in the group.

From this analysis, I think you must have plainly seen the remarkable interdependence which exists between different diseases—how they act and re-act on one another; and I think you must have been especially impressed with the extraordinary influence exercised by the vestiges of disease. But in order that we may fully appreciate the importance of the vestiges of disease as germs of fresh

diseases, and as causes of death, it will be necessary to carry the analysis beyond the little group which I selected as examples.

In this Lecture, I must attempt to show you *to what extent one vestige of disease, or the vestiges of one disease, may act as essential antecedents and as causes of death in other diseases.* To avoid monotony, I will select, as examples, some diseases of which I have not yet treated. I will take some from the Registrar's report, and some which have no place there. This will enable you to observe how many of the headings under which deaths are placed in that report owe their existence there to diseases which *never figure at all as causes of death.*

The first example I have chosen is *Anæmia*, the second is *Syphilis*, and the third *Fatty Degeneration.*

ANÆMIA.

A careful examination of the subject teaches us that Anæmia is one of the most frequent vestiges of all severe diseases, when they do not terminate in death—the patient remains anæmic during convalescence, and in a large number of cases, continues so long after returning to the duties of life. Again, we observe, that anæmia is continually occurring in connection with the periods of puberty and the cessation of the catamenia, and that during the intervening years, it is one of the most frequent forms of impaired health connected with derangements of menstruation, with lactation, with convalescence from the puerperal state, and during pregnancy.

Innumerable other causes may be found for this condition, which is, in fact, the type of most of those miserable states of health referred to by *The Times* in the memorable article already quoted—"There is a certainty worse than any occasional and precarious plague. We may anticipate it from our own experience—we may see the

great fact with our own eyes. . . . . It is not disease, but it is not health. It is a low state of vitality, of physical power, of mental energy, of enjoyment, and even of moral strength. . . . . Shocking as it may seem, a plague once in twenty years seems but a light evil to so low a condition of humanity."

From a concatenation of circumstances, it so happens that the female portion of the population have to support the principal weight of this dire affliction. Anæmiated girls, anæmiated brides, anæmiated spinsters, anæmiated mothers, abound in the consulting room, the outpatient room, the hospital ward, the home; wherever, in fact, the physician's duties call him there they are to be found. Yet from the long list of diseases named in the mortality tables, this name, anæmia, is absent. Is it, then, a thing to be endured, but not to be feared? Is it a name for sickness only, and not *a cause of death?* Quite the reverse, gentlemen, the fact is that, like some individuals of great influence and importance, anæmia travels *incognito.* When we discover its various "*nommes de guerre,*" we are startled to find ourselves face to face with the impersonation of long-dreaded enemies.

Tabes mesenterica .	18·3	deaths	per week.
Croup	6·8	„	„
Measles . . .	25·0	„	„
Hydrocephalus . .	32·5	„	„
Whooping-cough . .	51·1	„	„
Pneumonia . . .	60·3	„	„
Dentition . . .	12·8	„	„
Diarrhœa . . .	17·5	„	„
Convulsions . . .	36·5	„	„
Bronchitis . . .	64·5	„	„
Childbirth . . .	4·3	„	„
	329·6	„	„

These are some of the names under which anæmia

travels among the sick, and takes its place in the bills of mortality. The way in which it does so is as stealthy as it is deadly. I will tell you something of how it happens.

"Among the children of the poor of London, the most widely-spread of these diseases (tuberculosis, scrofulosis, rickets,) *is rickets*. It is, however, by no means limited to the poor, or to London, or even to large towns." I quote from one of the most correct medical philosophers of modern times.—(Dr. JENNER, *Lectures on Rickets*, *Medical Times and Gazette*, March 17, 1860.)

"Rickets is essentially and purely a disease of nutrition, not of one part only, but of the whole body."

"Rickets causes, primarily or secondarily, more deaths than any other disease of childhood."

"The great causes of death in rickets are:—1. Intensity of the general cachexia. 2. Catarrh and bronchitis. 3. Albuminoid infiltration of organs, especially of the lymphatic glands and spleen (but also of the liver). 4. Laryngismus stridulus. 5. Chronic Hydrocephalus. 6. Convulsions. 7. Diarrhœa."

You see, gentlemen, how closely this list of the causes of death in rickets corresponds with the list I have just given of what I have called the "*nommes de guerre*" of anæmia; and the correspondence is really closer than it appears at first sight.

"The connection between rickets and *laryngismus stridulus*," continues Dr. Jenner, "is very close. . . . . I believe the reason of laryngismus stridulus being so constantly referred *to teething* is that the rickety condition retards the development of the teeth, and the medical practitioner refers the laryngismus to that which, like itself, is the consequence of constitutional disease.

"If a child pass over the ninth month without teeth, you should carefully inquire into its cause. . . . . It may

be, and this is infinitely the most common cause of late dentition, that the child is ricketty."

Many deaths, therefore, registered under the head of DENTITION, may be referred to *rickets*.

"Catarrh and BRONCHITIS," says Dr. Jenner, "are unquestionably the most common causes of death in rickets. The softening of the ribs rendering the mechanical power by which inspiration is performed so defective, that the impediment offered to the entrance of the air by the mucus in the bronchial tubes cannot be overcome; and collapse of large portions of the lung follows.

"This want of inspiratory power, and the consequent accumulation of mucus in the bronchial tubes, affords an explanation of the extraordinary mortality of *measles, whooping cough,* and bronchitis in rickety subjects."

Thus may we refer two more of the headings of the Registrar—MEASLES and WHOOPING COUGH—to rickets.

For similar reasons, and still more from the intensity of the general cachexia and the corresponding defect in the V.M.F., rickets will be found to be the true cause of fatality in many of the deaths registered under the name of PNEUMONIA.

Then we have the deaths from CHILDBIRTH 4·3 per week, and it is very interesting to trace out the influence of rickets in causing these miserable deaths. The mode of its operation is twofold. First, there is the large size of the head in the rickety fœtus; and, secondly, deformities of the pelvis in women who have been rickety in their childhood. On examining into the causes of death in childbirth, as carefully collated by Dr. R. Collins, of the Dublin lying-in hospital, I find that of eighty-one cases of death during parturition, thirty-two were due to rupture of the uterus, eleven to tedious or difficult labour. If we, then, enquire into the causes of rupture of the uterus and tedious or difficult labour, to which forty-three

out of eighty-one deaths were due, we find that narrowing and deformity of the pelvis, and abnormal size of the child's head, stand prominently forward in their importance; and thus we are brought back to rickets as the chief cause of these deaths.

But you will perhaps ask, how anæmia is proved to be the cause of the deaths under these different headings, by proving that they are due to rickets? That is, in fact, the important question. The answer is this, that anæmia in the mother produces rickets in the child, and anæmia in the child may lead to rickets also. This may be as familiar to you all as it is to me; but I will give you the authority of Dr. Jenner again, who has devoted great attention to this subject:—

"The health of the mother has a decided influence in the development of rickets in the offspring. . . . . Of this much, I am sure—that when the mother is in delicate health, in a state of which *anæmia and general want of power* form the prominent features, without being the subject of disease usually so-called, there the children are often in a very decided degree *rickety*, although the father is in robust health, and the hygienic conditions in which the children are placed are most favourable." "It is very common for the first two or three children to be free from any signs of rickets, and yet for every subsequent child to be rickety.

"Whatever external conditions are favourable to the formation of hydræmic blood in a child, seem to be favourable to the development of rickets.

"Albuminoid infiltration of the lymphatic glands, spleen, and other organs is by no means an uncommon cause of death in rickets. The two great features, during life, of albuminoid infiltration of these organs in a young child, are emaciation and pallor; *the anæmia* is often most remarkable."

You will not fail, then, to see at once the intimate

connection between rickets and anæmia, and between anæmia and that list of terrible names in the Registrar's reports.

I do not wish you to suppose that I attribute *all* the deaths under those headings to anæmia; that would be a great mistake. But from an elaborate and careful analysis of such deaths, I have found, and you may find, that a very large, a very remarkably large, proportion of them are due to anæmia in the individual, or to anæmia in a parent and rickets in the offspring. It is important to bear in mind, that, with the exception of hydrocephalus, the diseases I have enumerated from the mortality-tables are extremely common every-day complaints—that they occur and *terminate favourably* thousands of times every year; that it is only *the fatal cases* that come into our list, and with which we are concerned. And what I have endeavoured to show, and what I wish to impress upon you is, that we must look to anæmia as the chief cause of this *fatality;* that it is anæmia in the individual or anæmia in a parent that brings these remediable, every-day complaints into the bills of mortality.

When, therefore we see anæmia establishing itself, as a vestige of the diseases from which our convalescents have lately suffered, or in any other way, we must regard it as the grim harbinger of death in a vast family of diseases.

Having pointed out to you in how many ways *anæmia* becomes a cause of death, although it has no place in the Registrar's reports, we will next examine into one of the diseases of which anæmia is a frequent vestige.

SYPHILIS.

Syphilis stands accused of only 2·8 deaths per week in the report already quoted; a number so modest compared

with the extreme frequency with which we know the disease occurs throughout the population of London and of all large towns, that you might naturally conclude, that *as a cause of death*, syphilis is hardly worth consideration. I shall easily show you, however, that this conclusion would be very distant from the truth.

In the first place, we have to take into account the relation between anæmia and syphilis. We have learnt that anæmia is one of the commonest vestiges of acute and chronic diseases—that it becomes established during protracted convalescence. Its relation to syphilis is that of a *vestige* of constitutional syphilis, which, again, is a vestige of the primary disease. It may, indeed, be taken as a good example of what I have called the vestige of a vestige.

Dr. Wilks states, in his valuable work on pathology (*Lectures on Pathological Anatomy, etc.*), the facts in which are gathered from Guy's Hospital, that in persons dying from *syphilitic cachexia*, the liver, spleen, and kidneys, are filled with a matter, "the same or very similar to lardaceous material;" and he believes that the following parts may also be the subject of this deposit, viz., the bones, skin, muscles, tongue, lymphatic glands, larynx, trachea, bronchi, lungs, heart, testis, brain-surface, nerves, and arteries, and that it may also affect the *fœtus*.

The same correct observer has recorded, that anæmia may be caused by conditions of the lymphatic glands, liver, spleen, and kidneys, closely allied to, if not identical with, these lardaceous affections, characteristic of the organs of persons dying from syphilitic cachexia.

In estimating the importance of syphilis as a cause of death, then, we have first to remember that it is one cause of *anæmia*, and that, therefore, a portion of the deaths which we have already traced to anæmia must be referred back a step further in their genealogy, and enumerated as the offspring of syphilis.

On referring again to the Registrar's Report for the ten years 1848-1857, we find 30·1 deaths per week under the head of PREMATURE BIRTH. Although the causes of premature birth are, many of them, still obscure or unknown, I shall easily show you the relation which a large number of them hold to syphilis.

Drs. Sinclair and Johnson (*Practical Midwifery, An Account of* 13,748 *Deliveries, etc., Dublin Lying-in Hospital*), examining into the causes of premature labour, found it, "extremely difficult to discover, with any degree of certainty, the causes of premature labour. . . . . Sometimes from an unwillingness to divulge the truth, but more frequently from an inability (on the part of the patients) to throw any light upon the subject." The same difficulty was found with cases of abortion. Therefore, syphilis may have been the cause in a large number of instances, besides those in which it was confessed or proved to have been so. Nevertheless, these gentlemen *certainly ascertained* that out of 199 cases of premature labour, syphilis was the cause in twenty-eight, or one-seventh; and in twenty-nine cases of abortion, one was confessed to be due to syphilis, and in eight, abortion had frequently occurred before, which makes it very probable that syphilis was the cause.

Dr. Robert Collins (*Practical Midwifery, Result of* 16·654 *births*) says: "We have no doubt, from the most attentive observation, that the cause of the death of the child in utero is, in numerous instances, *owing to a venereal taint* in the mother's constitution. . . . . Yet the mother may not have any marked symptoms of syphilis. In the hospital we have had repeated opportunities of witnessing such cases, where no doubt could exist as to the mother's being affected. We have known several instances of females having given birth to four or five or six *putrid premature* children, who, after the mercurial treatment had been adopted, gave birth to living children."

The same opinion is expressed by Mr. Whitehead, and still more forcibly by M. Diday, in his admirable little work lately translated by the New Sydenham Society. (*A Treatise on Syphilis in New-born Children, etc.*) "If," he says, "there be in pathology a truth strictly demonstrated, it is, beyond contradiction, the frequency of abortion in pregnant women affected with syphilis, and the direct power of syphilis to cause this accident. The annals of science actually swarm with observations, in which three, four, or even six deliveries in a syphilitic mother, inevitably terminate either in abortion or in the birth of syphilitic children."

"In general, it is *not after serious pathological derangements* that syphilitic women miscarry. It is during a state of health apparently intact, that the movements of the child cease to be felt, and soon afterwards it is expelled. As for the fœtus, there are sometimes found in it the signs or vestiges of the infection which has destroyed it. In other cases nothing can be recognised except the relative imperfections of its development. But sometimes all indications of this kind are wanting."

You will not doubt, then, the widespread influence of syphilis as a cause of those deaths registered under the name of PREMATURE BIRTH; and I beg you to observe especially how insidiously this influence is exerted, how liable to be overlooked, and hence how much more common it probably is, even than we are able to demonstrate by actual observation of its outward signs.

Next we come to 26·3 deaths per week registered under the comprehensive heading of ATROPHY AND DEBILITY; and I find that out of forty-five deaths from this cause in the week ending Saturday, May 29, 1858, from the same Registrar's report, thirty-four occurred before the age of twenty years. What, then, is the most probable cause of deaths, at this early age, for which no better heading could be found than Atrophy and Debility?

My own experience would lead me to place syphilis very high in the list of causes of such deaths. But I will give you the experience of others. First, however, let me point out to you that when syphilis acts as a cause of atrophy, it is not often in the subjects of its primary attack. In these the nature of the disease is generally known, and, therefore, appropriate treatment can, sooner or later, be applied, and hence the deaths from *syphilitic cachexia* in the persons of those who have themselves contracted the disease are comparatively rare. They are almost confined to cases in which the disease has been contracted again and again, under *very unfavourable circumstances;* and such deaths are so unmistakable in their character, that they are almost certain to be registered under their proper heading, as syphilis.

These few cases, therefore, will not affect the question. It is in the children of syphilitic parents, especially where the disease does not manifest itself in very perspicuous characters, and in the wives of syphilitic men, where the taint is not known to exist, or in whom its nature is concealed, that *atrophy and debility* become established in an intractable form.

"How many robust and healthy young persons do we not see," says M. Diday, "who marry syphilitic husbands, and retain all the attributes of health until their first confinement. From this moment, and although the confinement has terminated happily, they become feeble, and begin to lose flesh. Each new pregnancy aggravates this distressing condition. . . . . An effect of the disease in the fœtus, a disease which, without vitiating the humours of its mother to such an extent as to develope in her *the true syphilitic diathesis*, has effected in her organism a derangement only too real."—(Page 154.)

So real, in fact, as effectually to blight the unhappy victim. So much, then, for the wives; but the bulk of the deaths we are considering occur in children. Let us

see, then, how far these can be fairly attributed to syphilis.

Speaking of congenital syphilis, M. Diday says, "The frequency of visceral lesions in infants is now *beginning* to be appreciated; but they are still far from being recognised as often as they really exist. . . . . By their aid we shall be enabled to explain more rationally the *debility and deaths* so common in children affected with syphilis."—(Page 88.)

Again he says—"We know that the venereal dyscrasis never attacks an individual, *a fortiori*, an infant, without imparting to its constitution a *debility* which predisposes it to all kinds of organic and functional affections. Acute diseases occur more readily in it, and are more severe; catarrhal fluxes more persistent; *diatheses* more deep rooted."—(Page 119.)

After describing the more obvious signs of congenital syphilis, Dr. West observes: "Although such are the effects that may flow from infantile syphilis, when it runs its course unchecked, it yet happens but rarely that we meet in any case with all the symptoms that have just been described. *Most serious constitutional disturbance* is associated with the local mischief, and the child often falls a victim to the former when the outward signs of syphilitic disease are yet comparatively slight. It *wastes* rapidly, it suffers from sickness, or its bowels become much purged: it is constantly fretful and uneasy: the advance of ossification is arrested. In children affected by this syphilitic cachexia, not only are the loss of flesh, and that withered aspect which gives to infancy the appearance of old age, very remarkable, but also the bloodless state of the conjunctiva, and the yellow, waxen hue of the skin, like that of a person who has been reduced to the most extreme degree of anæmia. . . . . The duration of the disease, and the mode in which it proves fatal, vary in different cases; for while death some-

times takes place speedily under the first outbreak of its symptoms, life is in other cases prolonged for several months. In cases of this kind, the more marked signs of the disease recede for a time, either spontaneously, or under medical treatment, but the evidences of the syphilitic cachexia continue, the child never regains its health, glandular enlargements take place, and it either dies phthisical or else drags out a miserable existence until some intercurrent disease as *pneumonia* or *diarrhœa* supervenes and destroys it."—(*Diseases of Infancy and Childhood*, p. 549. 3rd edition.)

Having already discovered the powerful influence of the syphilitic poison in producing abortion and premature birth, it cannot give us any surprise to learn that many of those children who have survived their birth sink into a state of atrophy and debility, under the influence of a similar but less intense infection.

But, Gentlemen, there is yet another mode by which syphilis acts as a cause of death under this head. Imperfect nutrition is the most common cause of the atrophy of new-born infants.

"Whether," says Dr. West, "as sometimes occurs, the mother's milk is so deteriorated as to be unsuitable for the infant's support, or whether, as often happens, the child, having been weaned prematurely, its digestive organs are unequal to the task of assimilating the food that has been substituted for the mother's milk. In both cases, the abdominal viscera become disordered, nutrition is ill-performed, and the child falls into a state of *atrophy*."—(*Ibid*, p. 409.)

Now it is well known, that syphilis is a *not uncommon* reason for a child's being thus deprived of its natural food, either through the failing health of the mother, to which we have already referred, or to the advancing cachexia of the child, and its consequent derangements in the digestive processes, or to the direct effect of the

unhealthy milk upon its stomach; for one or all of these reasons, the child of a syphilitic parent is frequently *deprived of the breast milk.* We find, therefore, that we must place under *syphilis,* as a *cause of death,* another of the headings in the Registrar's report. WANT OF BREAST MILK caused 3·5 deaths per week in the ten weeks we have taken as our example, and a certain proportion of these must have been due to the vestiges of syphilis.

I am sorry to say that we have yet only included a small number of deaths under this heading, compared to the host which really belong to it.

I fear I should weary you with this subject if I passed all these matters before you in detail, and as some of them will engage our attention in another place, I will here only briefly allude to a few of the other vestiges of syphilis which swell the tables of mortality.

Degeneration of tissues is the first of these. Syphilis and anæmia may either of them lead eventually to this change, which, says Dr. Wilks, "is especially prone to attack those who have suffered any marked morbid blood disease."—(*Guy's Hospital Reports,* 1853.)

"Commencing fatty degeneration" is enumerated by this observer among the changes found in fatal cases of anæmia; and in another place he states that "constitutional syphilis may be fatal indirectly by *general degeneration of the tissues.*"

Hence you see that many of those deaths which are attributed to diseases dependent upon degenerated tissues, must be referred back to syphilis for their true cause.

The next of these vestiges of vestiges of syphilis is SCROFULA, that is to say, the *scrofulous diathesis,* or constitution. In enumerating the causes in which scrofula originates, Mr. Whitehead (*Causes and Treatment of Abortion and Sterility,* p. 55), places the venereal poison first in a list of five, the last of which is said to be "whatever has a tendency

to debilitate the vital powers, and induce, by long continued operation, a cachectic state of the system;" and he states it as his opinion that—

"The scrofulous diathesis sometimes originates in infancy or early childhood, where the constitution of the individual so affected has at first appeared sound and healthy, and no trace of it has existed in the parents or ancestors. The cause generally is a *syphilitic taint* transmitted through the mother; and such cases are by no means of uncommon occurrence."

Neither Ricord nor Diday have any doubt that scrofula may be a vestige of syphilis:—

"Is there in the parents," says M. Diday, "a certain form of lesion—a certain period of the syphilitic diathesis—which may more especially give rise to scrofula in their children?"

Ricord does not hesitate (*Lettres sur la Syphilis*, p. 249) to point out the tertiary stage as the most active cause of this transmission. According to him the affections of this phase may produce similar, *i. e.*, tertiary affections in the child. But yet "their specific influence upon the offspring," he writes in most of his recent works, "appears to go on decreasing, until it becomes at last only one of the hereditary causes of *scrofulous affections*."

M. Diday says—"The fœtus is, in short, *feeble*, scrofulous, or syphilitic, according to the dose of the poison which has exerted its influence upon it before or since conception."—(*Ibid.*, p. 122.)

In speaking of scrofula as a vestige of syphilis, Maisonneuve and Montanier have expressed their belief that it is not quite identical with ordinary scrofula proceeding from other causes; and M. Diday regards it as scrofula plus certain symptoms which give it additional power as a cause of fatality in other diseases. "As for the strictly pathological conditions," he remarks, "almost incessant outbreaks at the mucous orifices, accompanied by

glandular swellings and milky crusts soon destroy the beauties of childhood. Diarrhœa and catarrh, consecutive to whooping-cough, persist or return with endless tenacity. Rickets and curvature are added to the characteristic lesions of the osseous system. Convulsions or some serious derangements of innervation show themselves, and return without any appreciable cause. The face is ravaged by lupus, the hairy scalp by chronic eruptions, intercurrent diseases, even those the most foreign to this condition, appear to borrow from it an especial degree of obstinacy and severity."—(DIDAY, p. 124.)

According to Dr. Jenner, the leading pathological tendencies in *scrofulosis*, however produced, are "inflammations of the mucous membranes of a peculiar kind; so-called strumous ophthalmia, inflammation of the tarsi, catarrhal inflammation of the mucous membrane of the nose, pharynx, bronchi, stomach, intestines, inflammation and suppuration of lymphatic glands on trifling irritation, obstinate diseases of the skin, caries of bone."—(*Medical Times and Gazette*, March, 1860.)

To which Mr. Paget adds—Pulmonary phthisis, chronic inflammations of joints, and chronic abscesses.

In a certain number of instances there can be no doubt that all of these conditions of disease must be regarded as the vestiges of vestiges of syphilis.

In the opinion of Mr. Paget, "The relation (between scrofula and tubercle) is that the scrofulous constitution implies a peculiar liability to the tuberculous diseases, and that they often co-exist."

Dr. Jenner says, "I hold rickets, tuberculosis, and scrofulosis, to be distinct diseases in the same sense in which tuberculosis and cancer are distinct diseases."

And again, "Although we often find several members of the same family the subjects of rickets, of tuberculosis, or of scrofula, it is comparatively rare for members of the

same family to be the subjects of more than one of these diatheses."

Quite independently, however, of this disputed relationship between scrofula and tubercle, we have such good authority for classing syphilis among the causes of phthisis, that we are forced to ascribe to it some influence in that appalling item in the Registrar's Report, 135·3 deaths per week from PHTHISIS.

We have also good reason for allotting to syphilis some of the 4·4 deaths per week registered under the head of PERITONITIS, first, because of the well-known influence of scrofula as a cause of chronic peritonitis, and the relationship which we have shown to exist between scrofula and syphilis; secondly, because of the direct influence of syphilis upon young children, who become the subjects of peritonitis.

"It is worthy of notice," says Dr. West (*Diseases of Infancy and Childhood*, p. 501), "that in many instances of peritonitis in the fœtus, traces of syphilitic disease are observed upon it, or there is clear evidence of the existence of venereal taint in the mother. In such cases, the inflammation of the serous lining of the abdomen is probably due to the altered state of the circulating fluid—a cause to which, in after life, inflammation of the serous membranes is frequently owing. In the only instance of non-congenital *peritoneal inflammation* that has come under my notice in *early infancy*, there was no other cause than this to which it could be attributed."

Of the 4·9 deaths per week under the head of LARYNGITIS, we may be quite sure that some were syphilitic, syphilis and tubercle being the two principal causes of chronic laryngeal affections. But I shall weary you if I enumerate any more of the endless vestiges of syphilis and of the deaths which may be attributed to this cause. I think I have shown you quite enough to prove that the modest charge of 2·8 deaths per week placed to the account of

syphilis in the Registrar's report, conveys an impression quite opposite to the truth. You will not fail to see in a strong light, not only the wide-spread influence of syphilis as *a cause of fatality in disease,* but also the vast importance of distinguishing between the *coincidence* of death with the existence of any disease, and the *causes* of that death.

FATTY DEGENERATION.

In the present day, Gentlemen, we have all learnt that "something much more than a general tendency to form fat, or a general excess of fat in the blood is necessary to produce a local fatty degeneration."—(*Paget's Lectures,* Vol. I., p. 112).

Every year throws new light on the physiology of the process by which this change is brought about; but of this it is not within the province of these Lectures to treat. I wish, however, to point out to you that the pathological condition termed fatty degeneration is to be regarded as a *vestige of disease*—a vestige of perverted assimilation, either local or general, and hence a vestige also of any diseases by which such perverted assimilation is produced. In the third series of *Guy's Hospital Reports* (Vol. iii. 1857), Dr. Wilks has related a number of interesting cases of fatty degeneration, of which the only appreciable and probable causes were hæmorrhage, diarrhœa, miasmata. In these cases the subjects were comparatively young, the heart was the organ in which the diseased change was most marked, and the body generally was neither fat nor wasted.

Fatty degeneration appears to be especially prone to occur in tissues which have passed from a condition of active assimilation to one of comparatively inactive or feeble nutrition, by whatever cause this change may have

been brought about. Thus, the tissue of voluntary muscles is particularly subject to fatty degeneration; it is also peculiar for the vigour of its normal assimilation, and it is when this is rendered feeble that degeneration occurs. This appears to be the case whether the vigorous assimilation is hindered by arrest of function in the muscles, as in the case of paralyzed limbs, or by deficient supply of blood, as in disease of the nutrient arteries of a part, or by a depraved condition of the blood supplied to the part, as in the case of persons who, after having led active muscular lives, gradually become anæmiated by passive hæmorrhages. I have seen many instances of strong men, accustomed to vigorous country occupations, who, having become the subjects of bleeding hæmorrhoids, by which the blood lost its red globules, and nutrition became enfeebled, suffered from degeneration of their previously strong and vigorous hearts. Many other examples might be adduced of the degeneration of tissues when their assimilation is changed from a vigorous to a feeble state. Thus we find, in watching the course of diseases of the heart, that the heart which has become hypertrophied in opposing some obstruction to the circulation during the *active* life of the individual, becomes degenerated when, in the further progress of the case, the patient is forced to relinquish active pursuits, and thus ceases to call upon the hypertrophied organ for the full exercise of its muscular power. Thus, also, parts which have been inflamed are especially liable to degenerate, and fatty degeneration frequently takes place in organs deprived of their proper functions by disease, as in kidneys spoilt by Bright's disease. Thus, also, the products of inflammation, when they have no further functions to perform, are peculiarly subject to fatty degeneration. Without pressing the subject further, I think we shall all agree that fatty degeneration must be regarded as a vestige of disease, not as a disease in itself, and that in thus regard-

ing it, we must often look beyond the defect in assimilation to the causes of that defect, in order to find the disease of which the degeneration is truly a vestige.

I must now proceed to show you to what a wide extent this vestige of disease acts as a cause of those deaths classed in the Registrar's report under the heads of a variety of diseases.

"The most interesting examples (of fatty degeneration)," says Mr. Paget, "are those of *primary degeneration of blood-vessels.* This has long been known in the *atheromatous disease,* as it was called, of the larger arteries, the true nature of which, as a fatty and calcareous degeneration of the inner and, consecutively, of the middle arterial coat, was discovered by Mr. Gulliver (see *Med. Chir. Transactions,* Vol. XXVI.) The descriptions of this complaint by him and by Rokitansky have left nothing unsaid that is yet known ; but the observations are each year becoming more numerous and more interesting of similar changes in the minutest blood-vessels. Such changes are especially observable in the minutest cerebral vessels, and their importance in relation to APOPLEXY of which they seem to be the most frequent precedent, cannot be overstated."—(*Ibid.*, Vol. I., p. 139.)

Dr. Wilks' experience has taught him that, "In the majority of cases of sanguineous apoplexy, disease of the blood-vessels exists."—(*Lectures on Pathological Anatomy,* 1859.)

Dr. Kirkes has shown (*Med. Chir. Transactions,* Vol. XXXV.) that PARALYSIS, consequent upon arrested circulation in some portion of brain, is frequently the result of the obstruction of healthy cerebral arteries by masses of fibrine carried into them, after being dislodged from the valves of the left side of the heart, or from some part of the arterial system.

And Dr. Ormerod has pointed out that it is in the

cachectic subjects, with feeble circulations, that such masses are likely to form in the heart, in the very persons, in fact, who are likely to be the subjects of fatty degeneration of this organ.—(*Observations on the Clinical History and Pathology of one form of Fatty Degeneration of the Heart*, by E. L. Ormerod, M.D. *Medical Gazette*, 1849.)

And although Dr. Omerod was not prepared at that time (1849) to consider the occurrence of fibrinous clots in the subjects of fatty degeneration to be more than a frequent coincidence, we do not now doubt that the languid circulation, and the inefficient contractions of the heart in the subjects of fatty degeneration, act, together with other circumstances, in causing these deposits of fibrine from the blood.

Describing the appearances after death in fatal cases of DELIRIUM TREMENS, Dr. Wilks says, "The body, as a rule, presents many degenerative changes, brought about by the intemperate habits. It is this alteration of the viscera, I think, to which death is owing. Delirium tremens is a recoverable affection until such changes have occurred in the tissues that improvement is no longer possible; and we then find in the body various morbid changes. These are mostly of the *fatty* kind, as all alcoholic drinks tend to this condition."—(*Ibid.*)

In ANGINA PECTORIS, again, Dr. Wilks, in common with other observers, has found that "the heart is usually fatty, and the coronary arteries ossified."—(*Ibid.*)

"It is impossible," says Dr. Ormerod (*Ibid.*), "to read any collection of cases of angina pectoris without . . . . feeling how much further fatty degeneration goes to explain the symptoms than does any other morbid change usually found on dissection."

Mr. Paget classes the heart and arteries first among the frequent seats of fatty degeneration.—(*Ibid.*, Vol. I., p. 116).

Among the vessels of which the coats have been found degenerated are those of the lungs and placenta; and pulmonary or uterine hæmorrhages may result from this state of the vessels.

Against the extreme vital depression which accompanies such diseases as PERITONITIS, INFLUENZA, and DIARRHŒA, the subjects of fatty degeneration have no resisting power; they are among the first to succumb; and thus fatty degeneration becomes a cause of death in these and other depressing diseases when they attack adults.

Out of 164 deaths from CHILDBIRTH in the Dublin Hospital, during the seven years ending November, 1826, as recorded by Dr. R. Collins, I find thirty-two attributed to rupture of the uterus, and eleven to tedious or difficult labour. Recent investigations into the causes of rupture of the uterus, show that fatty degeneration of its walls is a most frequent if not a constant coincidence.

Fatty degeneration of the uterus, then, is a cause of death in childbirth by producing or disposing to rupture of the organ; but it has yet another influence on these deaths, for we may be quite sure that a degree of degeneration must often exist, not sufficient to lead to rupture, but quite sufficient to render the organ incompetent to vigorous muscular contraction, even under the influence of unusual stimuli. And thus it may become the cause of those hopelessly tedious labours which, as we have seen, assist to swell the death-rate in parturition.

Thus do we see, Gentlemen, that among the rational causes of dread that haunt the brain of the accoucheur during a tedious labour, fatty degeneration of the uterus has a right to stand foremost.

In PNEUMONIA, Dr. Wilks says that, in "far the majority of fatal cases, some pre-existing and more

chronic disease is found in some organ of the body."—(*Ibid.*)

Speaking of the probabilities of death in pneumonia, Dr. Walshe has made the following very well-considered observation—

"There are certain other circumstances (besides treatment) beyond the control of the physician, which exercise a most indubitable influence on the issue (of pneumonia). Among these, the pre-existence of *organic disease and the state of health generally of the individual* hold an important place. But of all the collateral conditions, age is the most important. While at the two extremities of life, in the new-born infant and in the octogenarian, pneumonia is almost inevitably fatal, the mortality between the ages of six and twelve years scarcely exceeds two-and-a-half per cent."—(*Manual of Diseases of the Chest*, 2nd edition, p. 438.)

To this I would add, that the octogenarian may be represented at any period of life by the subject of fatty degeneration.

I need hardly remind you that, in protracted Chronic Bronchitis there is no one feature more fearfully prognostic of a fatal issue, sooner or later, than the co-existence of fatty degeneration.

In speaking of Senile Gangrene, Mr. Paget says it occurs, "as its name implies, in the old, and often in those who are *old in structure* rather than in years; it affects tissues already degenerate. . . . . I think that, in some cases, its beginning may be when the progressive degeneration of the part has arrived at death. But, if this do not happen, some injury or disease, even a trivial one, kills that which was already nearly dead, as a *severe* injury might kill any part, however actively alive."—(*Ibid*, Vol. I., p. 461.)

Under the heads of Liver-disease, Jaundice, and Kid-

NEY-DISEASE, I may mention some interesting cases examined by Rokitansky. (*On Fatal Steatosis — Fatty Degeneration—of the Liver and Kidneys.*)

"The cases referred to consisted in steatosis of the liver, accompanied by a high degree of steatosis of the kidneys. Their importance rests upon the possibility of proving them to be parallel to the cases of acute atrophy of the liver, and the analogous renal affection which co-exists with it.

"It is evident that in our cases we have not to deal with that steatosis of the liver which occurs so commonly in the course of consuming suppurative processes, but with *fatty livers*, as they not rarely develop themselves to a high degree, at the side of an abundant formation of fat in the areolar tissue, without the disease being always attributable to gross feeding.

"There exists thus a *steatosis of the liver*, occurring in individuals inclined to the formation of fat, to which sooner or later a *steatosis of the kidney* is added, both which diseases attain slowly and imperceptibly so high a degree that, finally, a cessation of the biliary and urinary secretion supervenes, and, after a slight degree of icterus, death rapidly sets in from anæmia and a hæmorrhagic decomposition of the blood."—(*Ranking's Abstract*, Vol. XXXI., p. 40.)

Gentlemen, I might prolong this subject much further, —so widely spread is the influence of this seemingly spontaneous atrophy, this vestige of disease. I might give you quotations from reliable authorities to show in how many more diseases than I have yet referred to, the *fatality* is determined by fatty degeneration; but I should exhaust your patience and overstep our time. I will therefore conclude the list by simply enumerating the causes to which death was attributed in sixty-eight cases analysed by Dr. Quain, in all of which

there was fatty degeneration. — (*Med. Chir. Transactions.* 1850.)

LIST OF CAUSES TO WHICH DEATH WAS ATTRIBUTED IN SIXTY-EIGHT CASES OF FATTY DEGENERATION.

Rupture of the heart.
Exhaustion.
Coma.
Pleropneumonia.
Syncope anginosa.
Cardiac apoplexy.
Syncope.
Cancrum oris.
Gradual decay.
Lethargie.
Hæmorrhage into the pericardium.
Cerebral hæmorrhage.
Diarrhœa.
Gangrene of the intestines.

I must briefly remind you, in the words of Mr. Paget, that "Fatty degeneration of the heart often introduces unexpected dangers into the *ordinary practice of surgery*. It is, I believe, not rarely the cause of sudden death after operations. It is one of the conditions in which chloroform should be administered with more than ordinary caution. They who labour under it may be fit for all the ordinary events of a calm and quiet life, but they are unable to resist the storm of sickness, an accident, or an operation."—(*Ibid.*, Vol. I., p. 129.)

To sum up, Gentlemen, we have seen that this vestige of disease, fatty degeneration, may claim as its victims a certain number of deaths out of each of the following headings of the Registrar's report :—

Apoplexy . . .	26·0	deaths	per week.
Paralysis . . .	23·7	,,	,,
Delirium tremens and intemperance . .	4·5	,,	,,
Angina pectoris and other diseases of the heart . . .	31·9	,,	,,
Pneumonia . . .	60·3	,,	,,
Diarrhœa . . .	17·5	,,	,,
Mortification . .	4·6	,,	,,
Influenza . . .	3·1	,,	,,
Peritonitis . . .	4·4	,,	,,
Childbirth . . .	4·3	,,	,,
Bronchitis . . .	64·5	,,	,,
Jaundice . . .	2·8	,,	,,
Liver disease . .	11·0	,,	,,
Kidney disease . .	4·9	,,	,,
	263·5	deaths	per week;

out of which fatty degeneration claims so large a share.

We pass on now, Gentlemen, to another and most important branch of our subject.

I must now speak more at length of those *states of health* to which I referred in my second Lecture, when I said that I should impress upon you that "*they are intimately related to the definitely marked diseases*"—those states so puzzling to the young practitioner, because they do not fall under any of the nosological headings which have been his landmarks in the study of disease—those states which, although perhaps *familiar in their aspect* to most old practitioners, are, nevertheless, most inefficiently treated, or not treated at all, because their interpretation is so little understood, and because their importance is not appreciated—*states which are not recognised as disease, but which certainly are not health.*

A family of four children were exposed to the infection of measles at the same time, and from the same source; all of them *were supposed to be in health at the time.* One had the measles simply and slightly; one had a severe attack of pneumonia combined with it; one indicated a disposition to typhoid symptoms, and was completely oppressed by the morbid poison; a fourth lingered in its convalescence, and was found to have become the subject of an eruption of tubercles in the lungs.

A party of friends, *all apparently in what is called health,* met at a funeral; they went together into a damp unwarmed cemetery chapel, on a raw winter's day, and returned together, one and all complaining that they had taken "a severe chill." They dined together and went to their homes. One suffered an attack of rheumatic fever; one had anasarca; one jaundice; another bronchitis; a fifth had pneumonia; a sixth diarrhœa; a seventh had erysipelas; and another had pleurisy. One coughed up a quantity of blood; while the rest got a restless night, and a cold in the head, and thought no more about it. These are no imaginary stories; analogous cases frequently occur within the experience of medical men in large practice. But what is their interpretation? Why did the same cause—the chill—produce such different effects, under external conditions, apparently the same? No doubt, the first answer which suggests itself is, that the circumstances, so apparently the same, must have been really different. Well, Gentlemen, I will admit that as the first step towards solving the difficulty. But I will insist that in a given case, the cause, so far as the chill is concerned, shall be the same in each individual; and the circumstances, so far as they are external, shall be the same for each individual. Nevertheless, these different effects shall be produced; and the reason we shall find to be this, that there are other causes and other circumstances, different in each case, existing

within the organisms of the sufferers, with which *the one cause—the chill*—has to combine in producing its effect, and that the effect is the result of this combination of causes, different in each individual.

Some of you, perhaps, will say that this simply means that the different effects are explained by the different *idiosyncrasies* of the individual. And I must warn you against adopting a word as the explanation of a difficulty, lest in doing so, you fail to investigate the multitude of facts which that word may represent. I have no objection to the word, so long as you bear in mind that you must be able to explain what it means, if it is to be accepted as any explanation at all. Professor Bernard has spoken well on this subject: "I discovered," he says, "that section of large divisions of the sympathetic nerve was apparently unattended with the slightest inconvenience, *as long as the health of these animals* (rabbits) remained perfect . . . . but as soon as a general debilitation of the system arose from want of proper nourishment, acute inflammation was produced in the organs deprived of nervous influence. We had, therefore, succeeded in artificially creating *particular idiosyncracies* in these animals, and could predict with certainty that, as soon as health failed, disease would arise at a given point. . . . . Morbid predispositions must, therefore, be viewed in the light of peculiar physiological conditions." And he concludes thus: "Let me advise you not to consider idiosyncrasies in the light of mysterious powers residing within the depths of our organs, nor as entirely novel functions superadded, as it were, to those which already exist. They must be viewed as mere manifestations of the ordinary laws of physiology."—(Bernard, *Lecture V., Medical Times and Gazette.*)

Health, Gentlemen, is *the normal physiological state;* and peculiarities in or divergencies from this condition must be regarded as greater or less *degradations of health,*

in proportion as they predispose to contingencies which increase the probabilities *of death before the normal term* —before the attainment of the ultimatum.

There are very few persons who pass through life in the normal physiological state. At some period of life almost every individual diverges, more or less, from this state in one direction or another; and during that divergence, although escaping an attack of what is recognised as disease, *he certainly is not in health;* and in almost every individual there is a tendency to diverge in some particular direction, during which divergence—*i. e.*, during that period of *degraded health*—he is particularly prone to certain classes of disease. In the case I have taken as an example of the effects of chill, for instance :— The man who had rheumatic fever, was already surcharged with uric acid. He who had jaundice was suffering from defective excretion by the liver, requiring only a certain increase in the defect, or of the demands upon the secreting function, to throw the secretion back into the blood. The patient who had anasarca was suffering either from hydræmia, or from defect in the excreting powers of the kidneys. The sufferer from bronchitis, I attended myself: he had chronic congestion of the bronchi, from repeated former attacks of bronchitis, and the circulation through his chest was defective, through a feeble degenerated heart; but he had been accustomed to pass as a man in health, competent to perform the onerous duties of a tax-collector and county-court agent. He who had an attack of diarrhœa, found in his bile ducts or in the intestinal mucous membrane a safety valve, by which he was saved from either anasarca, jaundice, or rheumatic fever. The subjects of erysipelas and pneumonia, and the man who had hæmoptysis, were already suffering from depraved states of the blood, or of the organs to which it was determined; and from which, in the last two cases, it escaped in different quantities;

while the patient who was attacked with pleurisy, was surcharged with urea from defective action of his kidneys.

These several persons, therefore, were suffering, when they considered themselves in health—before the occurrence of the chill—from *physiological conditions* to which we can attribute the particular form of the disease which was set up, by the addition, in each case, of one and the same cause, viz., the chill.—*But some escaped unhurt!* Because in them, the physiological state was sufficiently normal, that a resisting and reactionary power existed, which was competent speedily to restore the functions of the organs subjected to the shock of the chill, and to make them compensate for the temporary arrest by increased activity.

I have chosen this group of somewhat crude examples on purpose, that their meaning may be the more perspicuous. They, most of them, exemplify states of health dependent on the *fluids and excretory organs* of the body. It would be easy to bring many examples of degraded health consequent on disease attributable to the *nervous* system. Some of M. Bernard's experiments on the lower animals may serve to illustrate this subject very simply, although not conducted with precisely this intention. He found, for example, when injecting certain poisons into the blood, that "to poison the *fasting* animal, a dose, larger by one-third, was required than had been sufficient to destroy other animals in a state of repletion." From which, he concludes, that "it is perfectly clear that all this class of phenomena must be entirely referred to the agency of the nervous system, not to absorption."—(*Lecture VII.*)

"But while the animal is in some measure preserved from the noxious influence of certain poisons, through the rapidly-increasing debility of the nervous system, it becomes obnoxious to the action of morbid influences of a

totally different character . . . . To advance a characteristic example of this. When frogs have been kept for a long space of time in captivity, *their health declines,* and ulcerations arise around the nose and mouth ; the nervous system being, in this case, considerably depressed, the animal is of course found to resist much longer the action of strychnia and other poisons, while *parasitical affections* spread with fearful rapidity. Frogs are subject to the growth of parasitical fungi, which, after the lapse of a certain time, occasion the animal's death. Now, if a frog is placed in a jar, containing others affected with the above-mentioned disease, the *new-comer* sets contagion at defiance ; while, if another frog affected with ulcerations in the vicinity of the natural orifices is introduced into the jar, the parasitical vegetation covers it at once."—(*Ibid.*)

"It has been found that similar affections always have a strong tendency to affect animals in a low state of health. . . . . The decrease of nervous power equally constitutes a predisposition to putrid, contagious, and virulent affections—a fact well known to veterinary surgeons."—(*Ibid.*)

Another of Professor Bernard's experiments forcibly illustrates the influence of the nervous system in the causation of disease, he finds that "when rabbits are placed under total abstinence, they generally live a fortnight or three weeks ; but when certain branches of the sympathetic nerve have been previously divided, the animals die within a few days, when deprived of food, through *acute inflammation of the viscera* connected with the nervous twigs that have been divided.—(*Lecture V.*)

We see here that the inflammation is determined to particular organs by changes in their nervous relations. But that upon which I would particularly fix your attention is the fact, that "the section of large divisions of the sympathetic nerve was apparently unattended with the

slightest inconvenience, as long as *the health of these animals remained perfect.*"—(*Ibid.*)

Let us now return to the group of cases exemplifying the effects of chill, and consider one or more of them in detail. We will take the case of the man who became the subject of anasarca, from the pre-existence of chronic Bright's disease. It is a well-known and remarkable fact, of the greatest practical importance, that persons in whom the kidneys are undergoing the changes characteristic of chronic Bright's disease are scarcely ever, if ever, aware that anything is going wrong in their urinary organs. Even when the diseased changes have become complete, they live on for months in ignorance of the fact, until some secondary disease sends them to their physician.

"If a patient comes under treatment with chronic disease of the kidney," says Dr. Wilks (*Guy's Hospital Reports*, 1853), "scarcely a reference is made to the urinary organs, the disease requiring the vigilant eye of the physician to detect its presence. The patient may present himself with fifty complaints, and for the first time is the real disease discovered."

And again (*Lectures on Pathological Anatomy*, p. 451), "In consequence of the degenerative changes in the kidney being slow, there may not have been any noticeable symptoms of its disease, although predisposing to a serious result if any untoward circumstance should light up its morbid influence; and thus a diseased kidney is sometimes found to account for the most obscure cases admitted into Hospitals."

And these "Degenerated kidneys are one great cause of mortality after operations and injuries in the surgical wards."—(*Ibid.*)

But, obscure, undemonstrative, and hence unobserved, as this disease may be, its influence over the organism and the probabilities of life is wide and powerful. I shall

not, therefore, be wasting your time if I enumerate some of the modes in which this influence is exerted. Among the earliest effects of kidney disease are—

1. Diminished power of excreting urea.
2. An increase of the fibrine in the blood.
3. A loss of albumen from the blood.

"The urine no longer contains the normal constituents in proportions even approaching those of health. The quantity of urea passed in twenty-four hours, instead of ranging from 250 to upwards of 500 grains, as in health (the mean for men, as stated by Simon, being 432) it ranges from 30, or even lower, to 120 grains. The quantities of fixed salts, and also of extractive matters, are likewise less than in the normal secretion."

"Not only are these effete and perhaps very deleterious substances much reduced in quantity in the urine, and probably retained in the blood; but the urine contains, in varying but considerable quantities, many substances which ought to have been retained in the blood, and which cannot be separated from it in any great amount without detriment to this vital fluid, namely albumen and other constituents of the serum. Microscopical examination reveals the presence, also, of other extraneous matters. We observe, for example, several other constituents of the blood—blood in the form of casts of the uriniferous tubes, blood corpuscles, more or less altered . . . . . fibrine, in the form of casts and films. The microscope reveals, also, in the urine, various anatomical elements of the kidney, more or less degraded, showing that this organ has itself undergone, or is undergoing, some process of disorganisation. It may be rapidly losing its true secreting elements, those elements by which the important constituents of the urine are separated from the blood, and which, I repeat, if retained in it, render this vital fluid unfitted for its great purposes in the economy, more especially for the oxidising processes."—(Goodfellow.

Lecture III. Medical Times and Gazette, August, 1860.)

"So much, then, as to the urine. Now, with regard to the blood. . . . . The blood, as we have seen, is deteriorated; the water is too abundant; the serum is not the serum of health, it is less dense, and increased in quantity; the clot is not only much reduced in volume, in proportion to the serum, but it is soft, and often covered with a buff-coloured coat; the fibrine is increased, but, probably, it is also not the fibrine of health; and the red blood corpuscles are no longer capable of going through the normal changes of growth, development, and decay. The process of red blood formation is impaired, in some cases, perhaps, arrested; for while the proportion of white corpuscles is much increased, that of the red corpuscles is greatly diminished. When we consider the successive changes which these important bodies undergo from lymph, chyle, white corpuscles, up to the perfect red corpuscle, and the important part which these red corpuscles play in nutrition, secretion, respiration, and excretion, we are prepared to expect that these alterations in them, together with those of the blood in other respects, will not be without their effects upon the system. . . . . But in addition to these alterations in the natural proportions of the normal constituents, there are present in variable, but always in considerable quantities, highly stimulating, irritating, perhaps toxic matters—pure excrement, which can never be retained in the blood without more or less disastrous effects upon several great vital processes of the economy, and if generated in large quantities suddenly, or if intercepted in their way out of the system, through other channels, lead rapidly to death."—(*Ibid.*)

"In all these affections, there is another fruitful cause of defective nutrition, by which every other evil is aggravated; there is a general impairment of the digestive function. Many causes combine to produce this effect;

but the principal among them, as proved by numerous experiments, is the elimination of the urea by the *gastro-intestinal mucous membrane*, which invariably takes place when its excretion by the kidneys is prevented by disease in these organs, or by their experimental removal.

The experiments of Bidder, Schmidt, Bernard, Lehmann, and others, leave no room to doubt that "the secretion of urea and the ammoniacal salts is not only hurtful to digestion by its directly irritating the coats of the stomach, but also by its impairing the digestive power of the gastric juice, and so preventing the formation of normal chyme and chyle for the supply of fresh materials for the globules. It is pretty certain, also, that the saliva, the pancreatic juice, the intestinal juice, and even the bile itself, are deprived to some extent of their digestive properties by admixture with the urea or the salts of ammonia." —(Goodfellow. *Lecture IV.* Sept., 1860.)

"The effects upon the digestive process . . . . together with the small amount of blood corpuscles, not only interrupt in some measure the supply of protein elements of nutrition to the blood, but even the small quantity that finds its way there is prevented, by the want of oxygen, from being assimilated to the several tissues. The general nutrition of the body suffers. But not only are but little fresh nutrient matters brought to the tissues in a state fit for assimilation; the effete matters, especially the fats and the several hydro-carbons, are not oxidised and otherwise converted into forms by which they can be made useful to the economy or eliminated from it. . . . . The blood is charged with other impurities than those resulting from the fault in the kidney. It abounds in fatty matters, especially cholesterin, which become deposited in several tissues, taking the place of their own proper elements of nutrition, and interfering with their function. We find this in the heart and arteries, and even in the capillaries." —(*Ibid.*)

The lung tissue is nearly always in a state of sanguineous engorgement, and the minute air-cells, and smallest respiratory passages in at least the lower lobes, are more or less completely filled with muco-serous fluid.

"In the majority of cases the heart's-tissue is degraded, as we almost invariably find it in the dead-house; and so, also, is that of the arteries, and even the capillaries. *Atheroma* is deposited in considerable quantities, beneath the lining membranes, and probably in the interstices of the other anatomical elements." Independently of the other causes of retarded circulation and consequent congestion, "the heart, being supplied as it is with blood little better for the use of the system than venous blood, its action becomes irregular, fitful, convulsive; its proper rhythmical movement is destroyed." "It would not be difficult to explain very satisfactorily how the *nervous system* also must necessarily be affected, under the conditions of the blood, as we find them in these diseases in their several stages. I can only give a mere outline, and leave you to fill up the details. These conditions of the blood must interfere with the nervous system in many ways. In the first place, there is every reason to believe that the *urea* and other constituents of the urine, retained in the blood, exert a direct poisonous influence upon the nervous structure, and are quite sufficient to give rise to most of the symptoms, referrible to this system, which we observe in this disease. *Secondly*, the general state of innutrition from the causes which I have already alluded to, and the non-removal of the effete matters resulting from the waste which is constantly going on, must evidently tend to impair the nervous function. *Thirdly*, the general state of congestion, leading to undue pressure, as well from this as from some little œdema. . . . . These causes being in operation must . . . . necessarily impair or destroy, as the case may be, the nervous force,

whether it be directed to intellectual manifestions, sensual perceptions, voluntary and automatic movements, or to the influence which it exerts over nutrition, secretion, and excretion."—(*Ibid.*)

This account of the influence of Bright's disease of the kidney on the several parts of the organism, I have selected from the admirable, carefully-studied Lectures of Dr. Goodfellow, delivered at the Middlesex Hospital, and published in the *Medical Times and Gazette.* A course of Lectures of which every one of us may be proud; for a whole profession is elevated when such creditable works are produced by any one of its members.

From this sketch, then, Gentlemen, in which are detailed the chief effects of Bright's disease upon the urine, the blood, the digestive and assimilative organs, the nervous system, and the tissues generally, we may glean, that, from the first stage of the disease to its close, a gradual disturbance is taking place in every part of the organism. The whole economy of nutrition and repair is disorganised, and every process of life is more or less affected.

Nevertheless, as I have pointed out to you, this disease not only frequently, but generally, exists for a considerable time before it is detected. It is generally detected, as it were, by accident: that is to say, through some symptom of unusually deranged health, inducing the individual to consult his doctor, or through some circumstance inducing the doctor to examine his patient's urine; or much more often, as in the case I have taken as our example, the patient, *while supposing himself to be in health,* is exposed to some accidental chill, becomes suddenly anasarcous, and thus, in *the form of an acute disease,* characteristic symptoms are developed of which the real cause is the long standing affection.

Now, Gentlemen, the points on which I am anxious, just now, to concentrate your attention, are these:—

First. The host of *slighter and more anomalous symptoms of deranged health,* which must, of necessity, have been set up from time to time, in such a case as this, during all those early stages of the disease which preceded its accidental detection, or the manifestation of its graver and unmistakeable characters; and, hence, the number of occasions on which such a patient, still believing himself to be in tolerable health, must have sought advice from his doctor for different symptoms of dyspepsia, for nervousness, for headaches, for deranged bowels, for palpitation of the heart, for cutaneous affections, for a host of subjective impressions, leading to melancholy and hypochondriacism; in a word, for one or more of those states of functional derangement, which fill our consulting rooms and the out-patient departments of Hospitals and Dispensaries.—Those states—devoid of the excitement and sympathy attending acute diseases—which sap the joy and buoyancy of health from the daily lives of men.

That is the first point. The second is not less important, viz., The defect which must exist during the whole of this time in all those conditions upon which the normal manifestation of the V.M.F. depends; and hence the defect in the condition of such patients to resist the contagion of fever, to struggle through its stages when developed, to sustain the powers of life in an attack of bronchitis, of diarrhœa, of pneumonia, or of any other serious disease.

Besides these two, there yet is another point equally requiring our deep consideration; viz., That a period must exist *anterior to the development of the series of changes and of symptoms which I have detailed as effects of the kidney disease*—a period longer or shorter in different cases—during which the kidney disease itself is not yet established and brought to the state in which the organ first fails in the proper discharge of its functions; and

that during the whole of this time (this pre-organic stage as it might be called) the organism must be in an *abnormal physiological state;* and the patient must, even then, be exposed to innumerable functional disturbances.

Adding together this period, antecedent to the failure in the function of the kidney, and the period which commonly elapses between the first failure in its functions and the detection of the disease in the organ, I shall not be far wrong in stating, that, in the majority of cases of chronic Bright's disease, an abnormal physiological state has existed for years before the disease itself is recognised by the patient or his physician; during the whole of which time the V.M.F. having been defective, there has been in the organism, not only a special predisposition to the invasion of disease, but a special tendency to death whenever disease has occurred.

The reality and importance of such a period of disturbance as I have described, anterior to the establishment of structural change, and the probability that it extends over a considerable portion of time, are ideas entirely consistent with the pathological views of Müller and Virchow.

In the third Lecture I gave you sketches of some cases from my note-books, which especially illustrate this portion of our subject. It will not be necessary for me to do more than remind you of them here. What I have said in this Lecture concerning Diseases of the Kidney, and the cases I presented to you of uric-acid poisoning in its pre-organic and subsequent stages, apply in principle to all the rest.

The sum of it is this :—

1. The majority of diseases which we see excited by the various accidents of life are but the *manifestations of pre-existent physiological states,* which required only this last condition (the accident of life) to complete their development into the characteristic features of disease.

2. Those conditions "not recognised as disease, but which certainly are not health," are the *faint expressions* of these morbid physiological states, while still deficient in the condition necessary to complete their development into the recognised features of disease.

3. The multifarious and anomalous functional derangements which puzzle the physician, and make martyrs of the patients, depend, for the most part, upon the influence exerted by these morbid physiological states over the ordinary incidents of animal existence, which are thereby modified, coloured, and distorted.

4. During the whole of the time that the physiological conditions are disturbed, there is a greater or less defect in the V.M.F., and this defect, therefore, exists at a period anterior to what are usually understood as structural changes.

I shall endeavour to show you in the last Lecture that, if these propositions are true, there are no facts in medicine of greater practical importance.

END OF LECTURE V.

LECTURE VI.

Resumé—Correlation of Physical and Vital Forces (L.M.F. and V.M.F.) —Law for the Attainment of the Ultimatum—Application of this Law to Man—The V.M.F. susceptible of Change—Accumulators of Force and Matter—Transmission of Accumulated Force to succeeding Generations—Causes of Change in the V.M.F.—Results of Etiological Analysis—The Vestiges of Disease, as causes of the Essential and Predisposing Antecedents, and of the Causes of Fatality in Disease—Anæmia, Syphilis, Fatty Degeneration, as Causes of Fatality—Abnormal Physiological States, their Relation to definite Diseases—The earliest Deviations from a Normal Physiological State are remediable—Competency of the Organism dependent on certain Conditions—The Vestiges of Disease affect these Conditions.—Responsibility of Medical Men—Medical Creed—The Competency of the Organism may be restored through the Instrumentality of Man—How this Instrumentality may be exercised—Medical Duties—Proposal to institute a System of Periodical Examination—Mode of conducting the Examinations—Effects on the Public and on the Profession, sanitary, ethical, and financial—Hospitals should institute Examinations for the Poor—The Need of such a System Illustrated—Working of the System in Hospital and Private Practice—Important influence of Public Drinking Fountains and Medical Officers of Health on the Conditions of Life.

In this Lecture, Gentlemen, I shall endeavour to assemble, in co-ordinate succession, the principal ideas and conclusions contained in the preceding five Lectures; and, having done so, I shall lay before you the practical conclusions which appear to me to flow from them. I only hope that you will be able to follow the course of the argument thus summed up, and that it will bring you to the same conclusions as those to which I have been brought myself.

In the first and second Lectures, I briefly discussed the very difficult and still incomplete subject of the Correlations of Physical and Vital Forces in their different manifestations. I attempted to show you that there is but one force throughout nature. That what we are accustomed to recognise as different forces are but modes or forms of one force. That the force of gravity, the force of magnetic attraction, the force of chemical affinity, the force of expansion by heat, the force of traction, propulsion and impetus, the force of development and growth in the vegetable, the force of development and growth in the animal, the force of assimilation in the vegetable and in the animal, the force of resistance to the invasion of disease, the force of repair after injury or disease, the force of reproduction of the species, and all the forms of force which we witness in the mechanical operations, performed by the muscles of animals,—the turning of mills, lifting of weights, excitation of heat by friction or by concussion, and the like; that each and all of these are but modes or forms of the same force. The nature of this force itself, as separated from matter, is beyond the limits of human knowledge. In the words of Mr. Grove, "Causation is the will, creation is the act, of God."

We know of the existence of force only in its connection with matter. We know of the different modes of force only in its connection with different modes of matter. The only ideas we can form of the attributes of quantity or quality in force, at any given time, are inseparably connected with certain attributes of matter. In short, *we only know of the existence of force in any form or mode by the concurrence of those conditions which render its existence in that form or mode possible.* These modes of matter, then, are, so far as our cognizance of force is concerned, the conditions of its existence. Only it must always be borne in mind that force cannot be

annihilated, and only changes its place or mode when any given conditions of its existence change their place or mode.

In conformity with these ideas, Gentlemen, I proceeded, in the first Lecture, to examine the processes of development, growth, and nutrition, and the repair and reproduction of the organism, as witnessed in a number of examples throughout the animal kingdom, which I presented to you in the form of an appendix for your more leisurely consideration. From this review of a number of facts, I endeavoured to lead you to the conclusion that, from the first production of the embryo until the end of the complete animal's career, all the processes of life, including protection from the invasion of disease, support under disease, repair after disease or injury, and the reproduction of the species, are manifestations of this same force to which I have just referred. I also endeavoured to show you that throughout the animal kingdom, all these manifestations of force are found to follow a *regular* course, the end of which is the attainment of a certain object—that they occur according to certain rules, and that a comprehensive view of these rules appears to justify us in the conclusion that, in the wise and perfect plan of creation, all these phenomena of animal life are governed by a *general law*, which I called the "law for the attainment of the ultimatum;" and which I attempted to express thus: "At every period of an animal's life, the force, or V.M.F., will be sufficient, in every respect, and determined in that direction, essential at the time, to the attainment of the ultimatum."—This *ultimatum* being understood to apply to the species.

According to these rules, or in obedience to this law, we found that, in the *lower forms* of animal life, the force is manifested in the production of certain complete organs, such as limbs and antennæ; whereas, *in man*, the advanced development of the intellect, and of the nervous

system, the gift of a moral and religious endowment, and his complicated relations with the outer world and with his fellow creatures, so alter the *conditions of existence* that it is essential for the force to *be determined in him* to the preservation of completeness in his complex and delicately correlated organism, amidst the no less complex circumstances by which it is surrounded.

In the normal constitution of the animal, then, we discover:—

1. A provision against the invasion of disease.
2. A provision against the destruction of parts under the influence of disease.
3. A provision for the restoration of parts when injured.
4. A provision against the destruction of the life of the individual by disease.

But I endeavoured to prove to you in the second Lecture, that as this force is dependent for the modes of its existence, and hence, for the attributes of quantity or quality, upon the concurrence of certain modes of matter; so, of necessity, it is subject to changes in those attributes, by changes in those concurrent conditions which render its existence possible in those modes.

This proposition, I stated to you thus: "The V.M.F. may be altered in quantity and quality by numerous causes."

In the next place, I pointed out that an animal, when sent into the world is possessed of a certain amount of matter; and a certain amount of force, manifested in the processes of life; and that the continuance of its existence depends upon its possessing accumulators of fresh force and of fresh matter. I attempted to show that the plan of organisation of all living things, however simple or complicated, provides them with such *accumulators of force and material;* and that, by these means, an accumu-

lation of matter and force takes place, by a succession of transferences, from the inorganic world; and I pointed out, as a necessary conclusion from the premises given, that the constitution of the animal, both in material and force, is dependant on the condition of the world in which it exists, and subject to alterations correlative with those of that external world itself.

Following up this subject, I presented to your consideration a hypothesis which appears to me to explain a larger number of the facts concerned, than any other with which I am acquainted; while it brings into unison some that have appeared antagonistic, and explains some for which no explanation has heretofore been offered.

I suggested that a certain amount of the force which has been accumulated and manifested in the processes of life, passes on into the germs of a new generation; and thus secures the multiplication of the species, carrying on from generation to generation the impress of successive changes in the sources from which it is derived.

Having attempted to make clear to you the dependence of the V.M.F. for its attributes of quantity and quality upon certain conditions, I endeavoured to lead you to the following conclusions:—

1. That the principal causes of changes in the V.M.F. may be arranged, for practical application, under three heads.

a. The conditions of life (that is, the circumstances which surround the animal, including the conditions of existence.)

b. Coetaneous diseases (that is, diseases existing together at one time.)

c. The vestiges of disease (that is, the remains and effects of pre-existent diseases.)

2. That these causes of change in the V.M.F. may affect the existing individual, a succeeding generation, or both.

In the fourth Lecture, I entered into an enumeration and analysis of the facts in the etiology of several diseases, which I took for examples, showing you the practical application of the theoretical conclusions at which we had arrived; and, at the same time, placing before you some of the facts upon which they were originally founded.

In this analysis I endeavoured to demonstrate, that when we analyse the natural history of any disease we find that the *principal causes of its essential antecedent, the principal causes of its predisposing antecedents, and the principal causes of its fatality*, assemble themselves readily under one or more of the three headings already pointed out; conditions of life, coetaneous diseases, vestiges of disease.

I then entered, more at length, into the natural history of several forms of disease, introducing quotations from various authors, that I might clearly show you, upon the authority of other observers than myself, and from observations made with objects different from mine, the unquestionable existence and verity of the facts upon which I had based my arguments. I showed you, not only theoretically, but from actual observations, how the organism becomes damaged by the vestiges of disease; how the V.M.F. becomes defective through these vestiges; how this defective state of the V.M.F. becomes *the essential antecedent* and *the predisposing antecedent of disease*; and *how the vestiges of one disease become the causes of fatality in whole families of other diseases.*

I endeavoured to prove to you, by the enumeration of facts, that the vestiges of disease become causes of fatality in other diseases, principally in two ways.

1. By destroying those modes of matter, and that correlation of conditions upon which the existence of the V.M.F. in its normal mode depends, and thus producing excessive defect in the V.M.F.

2. By producing excessive defect in the condition of some part of the organism, occupying the position, at the time, of an essential *instrument* in the processes of life, and thus causing the organism to break down at this its weakest part.

I pointed out to you, that in the large majority of deaths from disease, *the fatality is due, not to the disease itself, but to the vestiges of some pre-existent disease, operating in one or other of these ways.*

In illustration of this great fact, I placed before you the course of events, by which the vestiges of disease, passing under the names of ANÆMIA and FATTY DEGENERATION, become the actual causes of a large number of the deaths registered under the following names:—

Tabes mesenterica, croup, measles, hydrocephalus, whooping-cough, dentition, convulsions, apoplexy, paralysis, delirium tremens, intemperance, angina pectoris, diseases of the heart, pneumonia, diarrhœa, mortification, influenza, peritonitis, childbirth, bronchitis, jaundice, liver disease, kidney disease, and some others.

As an indication of the *insidious way* in which the deadly influence is exerted by these states, anæmia and fatty degeneration (which are only examples of a class); I called your attention to the fact that their names *do not* appear in the bills of mortality.

In further illustration of this part of my subject, I selected from the Registrar's Reports the name of a disease which *does* appear there, but which is only charged with causing a very small number of deaths: *Syphilis stands accused of only* 2·8 *deaths per week.* I then showed you, from numerous facts and the authority of reliable authors, that syphilis, like anæmia and fatty degeneration, is the actual cause of a host of deaths attributed to other diseases. In the first place, it is a frequent cause of anæmia and fatty degeneration, and thus, through them, of many of the deaths we have already traced to these

states; but, in addition to this, I showed you that it is the cause of a large number of those deaths registered under the names of premature birth, atrophy and debility, want of breast-milk, scrofula, phthisis, peritonitis, laryngitis.

I might have swelled this list much more, by showing how many deaths, classed under other headings, might be traced back to scrofula, often one of the vestiges of syphilis, and through it back to syphilis, as the actual cause; but my object was to give you plain and unquestionable examples rather than to weary you by pushing the analysis to its furthest limits. I hope, then, that I succeeded in making it evident, that out of nearly 600 deaths per week, registered under thirty headings, a very large proportion, indeed, can be referred unequivocally *for the actual cause of death* to the three states—*the three vestiges of disease; anæmia, fatty degeneration, and syphilis*; not for the cause of the disease under which they are registered, but for the cause of fatality in that disease.

I assume, then, Gentlemen, that I have shown you that the *vestiges of disease stand first among the causes of death.*

I have shown you, that so long as these vestiges exist, they are causes of defect in the V.M.F., and thus act as causes of the essential and of the predisposing antecedents of fresh attacks of disease.

I have shown you that the diseases, from which these vestiges result, are but the manifestations of pre-existent physiological states, to which, by some means, the last condition has been supplied, necessary to complete the *conditions of existence* proper to the disease which then is developed in its characteristic features.

I have shown you that these ABNORMAL PHYSIOLOGICAL STATES are indicated by the various conditions of impaired, general health, "conditions not recognised as disease, but which certainly are not health."

I have shown you, that these abnormal physiological states, recognisable under various forms of impaired health and attended by a legion of anomalous symptoms, may be traced back to still earlier periods in their history, when they require the greatest vigilance of the physician to detect any deviation from the standard of normal health.

Then I endeavoured to show you in what direction we must look for the causes of these earliest and most occult deviations from the normal physiological state.

With this intention I pointed out to you that the conditions of life and the vestiges of disease have a direct influence on the V.M.F.; that these alterations in the V.M.F. are transmissible to the germs of a succeeding generation; and that thus defects of the V.M.F. may be due to abnormal conditions of life in the individual, and to the vestiges, or vestiges of vestiges of disease in an ancestor. And I wish to draw your marked attention in this place to the fact, that it is to these defects transmitted from an ancestor, and to the conditions of life in the individual, that we must especially look for the causes of those first, insidious deviations from normal health.

I endeavoured to show you that these incipient and insidious degradations of the V.M.F. exist at a period anterior to such changes as are understood by the terms structural and organic; and I think you will now understand why I said in my last Lecture, that there could be no fact in medicine of greater practical importance than this. My reason was this; that the very dependence upon the conditions of life which exposes the V.M.F. in the individual to degradation under *un*favourable conditions, must render it amenable to *elevation* under the influence of conditions which are favourable. And thus we learn that there is a possibility of cure in states that would otherwise be beyond the reach of treatment.

In these facts, Gentlemen, you will not fail to see the extreme importance which we ought to attach *to those chronic diseases and to those slight deviations from the normal health*, which are commonly looked upon as of such small importance, as to be unworthy of the physician's thought and care, and safely to be trusted to time, to Homœopathy, or to an old-wife's nostrum.

In the third Lecture, we came to the conclusion, that there is *included within the functions of the organism* a competency to resist the invasion of disease, to conduct the processes of disease, when established, to a favourable issue, and to restore damages resulting from disease or injury. But, that this competency is contingent on the existence *of favourable circumstances*, and that these circumstances involve the following conditions:—

1. The position of the animal and of the part affected, at the time, with respect to the attainment of the ultimatum.

2. The state of the part affected and of all other correlated parts.

3. The state of the conditions of life.

4. The qualitative and quantitative state of the V.M.F.

Then I showed you the succession of events by which these conditions may one or all be rendered defective or unfavourable. I have especially sought to prove to you the power of the vestiges of disease to produce defects in the second and fourth of these conditions; viz., the state of the organs tissues and fluids of the body, and the state of the V.M.F.; and I hope I have satisfactorily demonstrated to you from the natural history of disease, *that defects in these conditions are* THE CHIEF CAUSES OF DEATH. In a word, I have attempted to show you, partly by theory, partly by observation, that the vestiges of disease and the conditions of life may determine the efficiency or non-efficiency of the organism to resist disease, to repair a

part, to preserve life, to produce an offspring, to endow that offspring with a normal V.M.F.

Here, Gentlemen, we find ourselves, at last, near the end of that cross-country ride, which I sketched out in my third Lecture. We have explored some of those different roads leading to the same end; we have discovered that some of those hills that appear to skirt the horizon, may descend into the mists of the valley when seen from another point of view. We have traced the lake, the stream, and the quicksand to its source. In spite of some difficult ascents, some uncertain footings, and many tangled paths, we have at length arrived at those *wells and springs of disease and death*, which we are so apt to neglect while busy with the disasters of which alone they have been the cause.

Gentlemen, we are all members of a *practical* profession. We have taken upon ourselves high and responsible duties, all culminating in action. So long as we choose to assume these duties in a profession, as yet so far from perfection, we are not justified in spending our time in scientific investigations or speculations, unless they have for their end some practical application for the good of humanity. It is the hope of attaining such an end which has led me on in the design and labour of these Lectures.

I think that such an end, such a practical application of the conclusions at which we have arrived, stands out plainly and unmistakeably before us. I hope, Gentlemen, that in your own minds you have anticipated me in coming to the same practical conclusion that I have arrived at myself.

I proceed at once to lay it before you.

In the beginning of the first Lecture, I asserted, that we are justified in practising the profession of medicine only in proportion as we believe in the articles of the following creed:—

1. That man may be the instrument through whom the invasion and progress of premature destructive changes in the human organism may be prevented or arrested.

2. That man may be the instrument through whom the damaged organism may be more efficiently repaired.

3. That man may be the instrument through whom the sufferings of the human being may be alleviated.

In what sense the organism is capable of accomplishing these ends *without* the instrumentality of man, I have shown you by numerous arguments and examples. I have also shown you the various modes *by which it becomes deprived of this capability.* The conclusion at which I now arrive is this, that man may be the instrument through whom *the capability of accomplishing these ends may be preserved and restored to the organism.*

The manner in which man is to exercise this instrumentality is the next point for our consideration. But I think we have almost reduced it to a necessary conclusion. For as we have plainly seen that the organism is competent to take care of itself, provided that it possesses a normal V.M.F., and is surrounded by normal conditions of life; and as we have also seen that the great causes of defect in the V.M.F., are *the vestiges of disease and abnormal conditions of life;* and as we have also learnt that the diseases, from which the vestiges result, are *invited*, by defects of the V.M.F.; and that when thus invited and received into the organism, they are capable of being disposed of without leaving vestiges behind, if the V.M.F. is free from excessive defect; that thus these vestiges are due to defective V.M.F. And as we have learnt that the earliest invasion of defects in the V.M.F., upon which all the long and intricate succession of ills depend as their germ—as we have learnt, I say, that this state of germination exists at a period anterior to the manifestation of disease in its ordinary characters, and that it is to be found in the garb of slight impairments of the general

health, the indications of which are more and more evasive and occult, the earlier the *stage of germination*; and, finally, as we have learnt that it *is in this occult and evasive stage of germination that the defect is most easily and most efficiently to be remedied*; I think you will agree with me in the practical conclusion at which I have arrived.

That the manner in which man is to exercise his instrumentality for the prevention of disease, the prevention of the vestiges of disease, and the prevention of fatality in disease, is to search out these earliest evasive periods of defect in the physiological state, and to adopt measures for their remedy. This appears to me to be the highest, the most ennobled duty of the physician, calling for the most abstruse knowledge of the science of life, the deepest experience in disease, the keenest exercise of the perceptive faculties, the calmest, most far-sighted reasoning, and the wisest judgment,—a duty as much above the management of acute disease as to rule an empire is above fighting a pitched battle.

Now, Gentlemen, I am perfectly convinced, from my own observation and experience in practice, that patients never think of consulting their doctors till these conditions of impaired general health have advanced far enough to have been developed into some form of disease: that thousands and thousands of people, believing themselves to be in health, are nevertheless undergoing these early, occult, and evasive stages of defect in the physiological state; and that such persons may be considered to be in health, not only by themselves, but by any one accustomed to associate with them, even though it be a physician, and that even if they submit to a medical examination, as ordinarily conducted, they may be declared to be in health.

I wish, then, to propose, as the only means by which to reach the evil and to obtain the good, *that there should be*

instituted, as a custom, a system of periodical examination, to which all persons should submit themselves, and to which they should submit their children.

Such an examination must include an inquiry into the family history, to learn the hereditary constitution; into the personal history, to learn all the previous diseases that have been passed through, and the habits and vicissitudes of life; into all the conditions of life surrounding the individual; into the condition of the organs and functions of the body; into the state of the secretions and fluids of the body by analyses and microscopical examinations; and so forth.

The examination should be reported in writing; and, after due consideration, such advice must be given as a careful judgment may dictate, for the future conduct, pursuits, and habits of the patient, with a view to correcting any defects or tendency to defects in the organism. Advice must also be given as to the means of removing any vestiges of disease that have been detected, or if they are not removable, advice as to the best way of overcoming their influence or of averting their increase. To this must be added precautions to be adopted in certain contingencies which, according to the judgment of the case, appear probable.

If such a plan as I have here proposed were to be faithfully and conscientiously carried out by the present and rising generation of well-educated studious medical men, I think no one can doubt, after a careful consideration of the subject, that immense benefit would be conferred *upon the public*. The next question is, then, what would be the effect *upon the profession* in a pecuniary and in an ethical sense. With regard to the pecuniary question, it is only necessary to observe that of course I do not expect that any man in good practice, whose time is profitably employed, could conduct such an examination and give such advice for the usual consultation-fee.

That is, of course, out of the question. Every man who attempts to follow out the plan, will, I hope, require such a fee as shall enable him to give the necessary time and consideration to every case.

But this should in no way interfere with the power of the *poor* to participate in such a system. Every hospital and dispensary, should institute a distinct department for the conduct of such examinations, and for giving the necessary advice. Every patient discharged from its wards should be submitted to this department before returning to the duties of life.

I have again and again referred in these Lectures to the numberless anomalous symptoms, the pains, discomforts, nervous disturbances, etc., etc., which affect persons in abnormal physiological states, and which increase in their severity, obviousness, and number, as the states of health become more and more degraded, and the occurrence of some acute disease becomes more imminent. I have pointed out to you that these are the states of health which fill our consulting-rooms and the out-patient departments of hospitals and dispensaries.

In further confirmation of my statements on this point I may remind you of some apposite observations of Sir Henry Holland's on the subject of symptomatic complaints. In his *Medical Notes and Reflections* he says, speaking of gouty blood—

"Irregular actions of the *heart, hypochondriacal depression,* as well as the more common symptoms of *dyspepsia* and *disordered secretions,* frequently antecede by months the first appearance of gout in the extremities, and occasionally give serious alarm even to those who look with medical eye upon these ambiguous cases."—(P. 246, 3rd edition.)

"Modern observation has led us to recognise some of these relations (of gout with local or constitutional disorders) under the names of *gouty headache, gouty ophthal-*

mia, and *gouty bronchitis.* My own experience would lead me to add many cases of *asthma* to the number. I have so often seen this disorder prevalent in gouty families, affecting those who do not undergo the disease in the joints, and ceasing wholly or in part when the gout appears externally, that I cannot doubt the existence of this relation.

"The greater tendency to *apoplexy* in this habit is noticed by many of the older writers, and confirmed by general experience.

"Reference has already been made to *hypochondriasis* and *hysteria;* and it is probable that other disorders of the same class, *still less generally viewed under this connection,* will hereafter be submitted to it.

"The relation of gout to the functions and disorders of *the liver* is another point of much interest in pathology, clearly attested both in the active symptoms of the disease and by those which are common under other forms of the gouty temperament. This, moreover, is one of the points associating it with that group of maladies bearing the vague name of *dyspepsia.*

"The connection of gout with *cutaneous affections* is an additional topic, yet almost unexamined; though I cannot doubt, from my own observation, that certain of these disorders occur as effects of the habit in question."—(*Ibid,* pp. 253-54.)

The enormous quantities of medicine dispensed in the out-patient departments of hospitals and dispensaries for the *temporary relief* of this class of functional derangements and local diseases—for complaints which might be prevented by the patients themselves if they were properly informed of the causes and premonitory symptoms of their maladies—these are facts which must be perfectly familiar to all my hearers. Such a system of examination and advice as I propose, if properly carried out, must strike at the root of these evils, and would at

the same time reduce the miserable over-crowding of the hospital waiting-rooms, and the enormous expenses incurred for drugs. These are considerations which, however important as elements of social and political economy, are elevated far above the rank of financial questions by the fact I have endeavoured to demonstrate in these Lectures, that *by these same means, and at the same time, we shall so largely promote the economy of life.*

I hope, Gentlemen, that you will draw the attention of the treasurers and governors of any hospitals to which you may belong to this subject. It is necessary to the credit and honour of our profession, that improvements in these medical establishments should not come from the public to us, but *should originate among ourselves,* and be urged by medical men upon the public attention.

The following sketch of a common complaint, and a common story, may illustrate the need for some such system as I propose. A lad of fifteen is admitted into a hospital ward with a first attack of rheumatic fever. He is treated with skill, and nursed with care, and in two or three weeks he is convalescent, and returns to his home without having received any damage to his heart or other organs. But he has no proper understanding of the nature of his complaint, of the conditions of life calculated to keep up the morbid influence in his organism, no clear notions of the diet which he ought or ought not to adopt, no knowledge of the premonitory symptoms by which a fresh attack of rheumatic fever is heralded, or of the precautions necessary when such an attack is feared. He has probably a general idea that his great enemy is cold, and his great friend flannel; and that is as likely to lead him wrong as right in the measures he adopts.

He goes back to his home and his pursuits apparently well. He keeps his skin closely cased in flannel, and his dwelling-rooms warm, but he neglects altogether to

provide for efficient excretion by the skin. He chooses a business, either utterly regardless of its fitness for his constitution, or makes as great a mistake by selecting one in which he may be sure of warm, that is to say close, rooms and workshops by which he is deprived of exercise and oxygen. He drinks beer, eats cheese, and so forth, like other people in his position. After a few months *he comes back* as an out-patient at the hospital, with severe acid dyspepsia, and after consuming the usual amount of drugs for several weeks, gets relief, and goes back to his old habits. A few months more, and he appears again, the subject of a skin-disease; goes again through the consumption of drugs, and gets well and goes back to work. By and by he comes again with diarrhœa, and goes through the same process; at another time with gravel, and gets relief again. At length, a few years perhaps having elapsed, and after some months of depressed health, with palpitations of the heart, gloomy thoughts, irritable temper, and general *malaise*, he happens to be out on a damp raw day, gets a chill, and applies again at the hospital, with a fresh attack of rheumatic fever. This time he suffers from endocarditis, and after some weeks returns again to his home, discharged cured, but with disease of the valves of his heart. He has been thoroughly well treated, and is very free from rheumatic poison, and hence goes on for a considerable time without much inconvenience; but having no clear ideas of the *nature of the damage he has received*, or of the precautions necessary to prevent its increase or the production of secondary diseases dependent upon this damage for their cause, he gradually becomes the subject of congested lungs and liver; of attacks of bronchitis to which he was not formerly inclined; his breathing becomes short, his old dyspepsia troubles, cutaneous affections and gravel, recur again and again, and his capability of following his former occupations gets less and less.

If he does not have another attack of rheumatic fever, he comes back to the hospital some future day with chronic bronchitis, or with apoplectic symptoms, or with congested liver, or still later with albuminuria and dropsy. At length he dies, and his death is registered under the head of apoplexy, heart-disease, or dropsy.

You will admit that this sketch is no exaggeration; that I have, in fact, omitted numerous details of minor diseases and discomforts, that are sure to have existed in the case itself. I have said nothing of the effects upon this man's children of his continued ill-health, or of the poverty and want of food brought upon his wife and family by the same cause, and *acting as fresh causes of disease in them*. But I have said enough to make it quite clear, that, in the course of a life prematurely ended, he must have consumed a vast amount of money in the form of drugs, and a vast amount of nervous energy, if not of brains, in the form of medical advice.

It is to the first causes, to the "wells and springs" of such a series of calamities as this, that I have directed your attention as fellow medical practitioners, and to which I now beg that you will direct the attention of the Treasurers and Governors of Hospitals and Dispensaries, of your private patients, and of the public at large.

To return to the question of the working of my plan among the several branches of our profession. My opinion is, that it would, in every respect, work advantageously. In the establishment of such a department as I have proposed in connection with public hospitals, it would open spheres of action to men of different tastes and capacities, who might work together for the common good. Thus, I would have the course of operations somewhat after this order. The patient should first present himself before a senior student or junior physician, who would take down his name, age, occupation, personal and

family history, the nature of the illness for which he entered the hospital, and the like; all this should be registered in writing upon a *schedule* provided for the purpose, with all the headings *printed* to save time. With this schedule, so far filled up, the patient should now appear before an examining physician and surgeon. By them, his personal condition would be ascertained and entered on the schedule. During this time, his *secretions* would have been under examination by a microscopist and chemist, who would fill in their report upon the schedule.

Finally, with the schedule thus filled up, he should appear before a senior physician and surgeon, by whom the document would be examined, and any further questions asked, if necessary. It would be their business to form an opinion as to the physiological state, the damages sustained, etc., and to direct the hygienic and other precautions suitable to the case. In order to save time, and ensure that these directions should not be forgotten, certain *forms of directions* should be drawn up, suited to all the principal abnormal physiological states, and damaged conditions, which should be kept printed and *numbered.* The advising physician and surgeon would only have to mark on the schedule the necessary *numbers*, and these forms of directions might then be *distributed by students*, who would thus become familiar with the right methods of preventive treatment in particular cases.

The working of the system in *private practice* would be after the same model, only that, of course, it would have to be conducted by fewer hands. The whole might be done by one physician; assisted, as the case might require, by a surgeon or an accoucheur, or by a microscopist, or an analyst, according as his time, or the versatility of his abilities might enable him to undertake the whole or a part

of the labour. I think, in most cases, men in good practice would associate themselves with microscopists and analysts, for the economy of time; and thus many members of our profession, whose tastes and talents attach them to these departments of medical study rather than to the examining and prescribing for patients, might find profitable occupation for their time.

Then with regard to the relationship between the consulting practitioners and men in general practice. There is nothing to prevent *general practitioners* from undertaking such examinations themselves. But the numerous and uncertain calls upon their time would, probably, stand in the way, and they would rather entrust the task to consulting men; in which case, I think, the connection between the two classes of practitioners would be of the most agreeable and advantageous kind. Suppose, for example, that a patient presents himself for examination once in six months. The course would be this. The consulting practitioner would make his examination and form his opinion. He would then have an interview with the general practitioner, learn any additional particulars from him, communicate to him his views, and the general conclusions as to the state and tendencies of the patient would then be agreed upon between them in consultation. These would be communicated to the patient; and in any diseases, which might occur during the interval between the periodical examinations, the general practitioner would bear in mind the leading tendencies and susceptibilities of his patient's constitution, as agreed upon at the last conference. If he needed a consultation, on the occurrence of disease, he would already be in friendly communication with the man most likely to be of use to him from his previous knowledge of the patient, and from his acquaintance with the general practitioner's own views of the case.

I think, therefore, that the working of this system

would be advantageous in every respect, and would tend to encourage *that feeling of mutual interdependence*, between the different branches of our profession, which is so much to be desired for the benefit of ourselves and of the public.

Gentlemen, throughout these Lectures, you cannot have failed to remark the important position occupied by *the conditions of life*. You have seen *unfavourable conditions of life* taking their place, again and again, beside *the vestiges of disease*, as causes of the essential antecedents, of the predisposing antecedents, and of the causes of fatality, in disease.

It did not lie within my province, and I had not time, to dilate more fully upon the necessity for constant vigilance, on the part of the medical profession and of the public, to keep these conditions of life in *a favourable state*.

But I cannot conclude, without expressing my deep sense of the debt of gratitude which is due from all men, to *two great hygienic institutions of modern times*. By which the conditions of life for the community at large have been so vastly improved, and by which, doubtless, they will be rendered, year by year, more completely favourable. I mean the institution of PUBLIC DRINKING FOUNTAINS and the institution of MEDICAL OFFICERS OF HEALTH.

END OF LECTURE VI.

APPENDIX.

The preceding Lectures were delivered at the Royal Infirmary for Diseases of the Chest, City Road, May 15th, 22nd, 29th, June 5th, 12th, and 19th, 1861.

EXTRACTS FROM H. MILNE EDWARDS' LECTURES.

"*Leçons sur la Physiologie et l'Anatomie Comparée de l'Homme et des Animaux.*" Paris, 1857.

Diversity of Beings.

"When the physiologist surveys the innumerable animals which people the surface of the earth, or which live in the depths of the waters; and when, without stopping to consider the external differences with which he is at first struck, he observes the manner in which life manifests itself in all these beings, and the mechanism of their organisation, he stands astonished at the sight of the almost infinite diversity which he remarks in them. The conditions of existence vary; the faculties differ; the instruments, even when they are affected by analogous usages, are not always alike; and anatomical or physiological differences are met with, not only between species and species, but amongst the different individuals of the same species, and even in the *same individual at different periods of its existence.* The primary characteristic of the great zoological creation appears to be, in effect, the *diversity* of *products.*"—(p. 12, Lecture I.)

"But when we come to study with more attention the whole animal kingdom, we soon perceive that Nature, in so largely satisfying the law of the diversity of organisms, obeys also a *law of economy.*"—(p. 13.)

Various Degrees of Perfection.

"All animals are, it is true, equally well constituted to fulfil the rôle which is assigned to them in the vast plan of creation; and in this point of view, we may say with Cuvier, that they are all equally perfect in their kind; but this role is far from having always the same extent and the same importance. With some, the results of the physiological labour are feeble, obscure, and rude. The acts vary but little, and are of extreme simplicity; the vital power is only exercised in a circumscribed sphere, and it readily becomes extinct. With others, on the contrary, the functions are multiplied to a high degree; life is complicated and prolonged; the faculties increase; and the functions of the organism are performed with no less precision than power."—(p. 14.)

Sources of Superiority.

"The relative superiority of a living being, like that of an inanimate machine, may depend either on the power of action with which it is endowed, or upon the greater perfection with which the organs perform their functions. In fact, in the organism, as well as in the labour of our manufactories, the *quantity* of the products is independent of the *quality* of those same products; and the importance of the results obtained is subservient to two distinct conditions: the power of the forces put in action, and the manner in which these forces are applied. The superiority of an animal in relation to those with which it is compared, may, then, depend on one or other of these causes: on the greater intensity of the vital power, or on a better employment of the force supplied."—(p. 16.)

Division of Labour.

"That which gives to animate beings a more or less elevated rank, is the *quality*, much more than the *quantity* of the products of the living machine. Now, in the creations of Nature, as well as in the industry of man, it is above all by the *division of labour* that this perfection is obtained."—(p. 16.)

"Amongst the animals whose faculties are the most limited, and whose life is the most obscure, all the parts of the body possess the same physiological properties; each may be sufficient in itself, and able to perform all the acts which we witness in the

whole. The individual is an aggregation, rather than an association, of productive agents."—(p. 17.)

"It follows from this, that amongst these animals, the destruction of any one part of the body does not incur the complete loss of any faculty; each fragment of the organism, if it comes to be isolated, may continue to discharge its functions as before its separation, and to act as the entire mass acted. There does not, then, exist *any division of the vital labour*, and each portion of the individual is at once an instrument of sensibility, of movement, of nutrition, and of reproduction."—(p. 18).

"It is otherwise as we rise in each of the series of beings, more and more perfect, of which the animal kingdom is composed. We then see the *division of labour* introduced more and more completely in the organism. The different faculties are isolated and localised; each vital act tends to be accomplished by means of a particular instrument; and it is by the concourse of dissimilar agents that the general result is obtained."—(p. 19).

Adaptation of Types to different Biological Conditions.

"As we pursue our investigations, we shall see, also, that the animals, formed after these different plans, vary amongst themselves, not only with respect to physiological perfection, but also by the adaptation of their organisms to *different conditions of existence*. Some are destined to live in the water, others upon the land; some are nourished by liquid substances only, others are called upon to use as aliments the solid remains furnished by organised bodies; and amongst the one and the other, we see some that live on vegetable matter, and some that sustain themselves solely on flesh. Hence there results a wide diversity in each branch of the animal kingdom; but here, again, the tendency to economy is manifested.

"In fact, the processes employed by Nature for thus adapting the organisation of animals to very different modes of life, are the same as the means adopted to render those beings perfect. It is first by impressing some slight modifications upon the parts already existing in the general type, then by more completely transforming those parts, that she adapts the structure of the derivatives from this type to new conditions of existence;

and she does not appear to have recourse to special organic creations, except when the system of modification (*emprunts*) no longer responds to these wants.

"It follows from this, that as regards the physiological perfection of beings, as well as the adaptation of the organisms to the varied conditions of existence, we find again in the different zoological groups a tendency more or less marked to the repetition of the same dispositions; and that in this manner Nature introduces in the different series thus furnished, a certain number of corresponding terms."—(p. 27.)

Anatomical Consequences of the Division of Labour.

"The further the speciality of action and the division of labour are carried, the more also the number of dissimilar parts and the complication of the machine ought to increase."—(p. 20.)

Function not dependent on an Organ. Physiological Substitutions.

"It is evident, that every vital act ought to have as a cause the agency of an instrument, or of some organ or other, the structure of which is adapted to the functions which this agent ought to fulfil. But it is a serious error to believe that a limited faculty can be called into exercise only by the aid of one and the same organ: Nature arrives at her wished-for result by different roads."—(p. 23.)

Co-ordination of Acts.

"Multiplicity of physiological instruments, and division of labour, are the principal means which Nature appears to have adopted to augment the degree of perfection with which she has endowed the different species of animals. But this increasing number of the agents of life, and this variety in their functions, necessitates the co-ordination of their acts, and this co-ordination is obtained by the hierarchy and centralisation of force."—(p. 23.)

Resumé.

"Thus, in studying each of the great physiological apparatuses, by the aid of which the faculties of the animal are exercised, it

will be necessary, in order to obtain a complete idea of them, to pass in review its mode of constitution, not only in the different zoological types, but also in the different states through which each of these types passes before arriving at its definitive form. And it will also be necessary to compare the one with the other, either to bring together the points of similitude, or to mark the dissimilitudes with which we meet."—(p. 34).

Conditions of Existence.

"As nothing can exist without the concurrence of those conditions which render its existence possible, *the component parts of each must be so arranged as to render possible the whole living being, not only with regard to itself, but to its surrounding relations;* and the analysis of these conditions frequently conducts to general laws, as demonstrable as those which are derived from calculation or experiment." — (Introduction to Blyth, Westwood, and Carpenter's Edition of Cuvier's *Animal Kingdom*, p. 15.)

To comprehend the full meaning of *Conditions of Existence*, the *struggle for existence* must be clearly understood, and constantly borne in mind.

"Nothing is easier than to admit in words the truth of the universal struggle for life, or more difficult — at least, I have found it so — than constantly to bear this conclusion in mind. Yet, unless it be thoroughly engrained in the mind, I am convinced that the whole economy of nature, with every fact on distribution, rarity, abundance, extinction and variation, will be dimly seen or quite misunderstood. . . . . .

"I should premise, that I use the term *struggle for existence* in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny." —(*Origin of Species, etc.*, by Charles Darwin, F.R.S., etc., p. 62.)

Organs or parts may, at different periods, occupy an active and essential, or a passive and subordinate position, in relation to the possibility of the animal's existence at those periods. It is in the active and essential position,

that they especially require our consideration in these Lectures.

"The points of structure in which the embryos of widely-different animals of the same class resemble each other, often have no direct relation to their conditions of existence. We cannot, for instance, suppose that, in the embryos of the vertebrata, the peculiar loop-like course of the arteries near the branchial slits are related to similar conditions, in the young mammal, which is nourished in the womb of its mother; in the egg of the bird, which is hatched in a nest; and in the spawn of the frog under water.

"The case, however, is different when an animal, during any part of its embryonic career, is *active, and has to provide for itself.* The period of activity may come on earlier or later in life; but *whenever it comes on, the adaptation of the larva to its conditions of life is just as perfect and beautiful as in the adult animal.*"—(DARWIN, p. 439.) . . . . . The fact is that "for the welfare of every young animal, as long as it remains in its mother's womb, or in the egg, or as long as it is nourished and protected by its parent, it must be quite unimportant whether most of its characters are fully acquired a little earlier or later in life. It would not signify, for instance, to a bird which obtained its food best by having a long beak, whether or not it assumed a beak of this peculiar length, as long as it was fed by its parents." —(*Ibid.* p. 444.)

THE CONDITIONS OF LIFE AFFECT THE GERMS OF A SUCCEEDING GENERATION.

"Under domestication, we see much variability. This seems to be mainly due to *the reproductive system being eminently susceptible to changes in the conditions of life; so that this system, when not rendered impotent, fails to reproduce offspring exactly like the parent form.* Variability is governed by many complex laws, —by correlation of growth, by use and disuse, and by the direct action of the physical conditions of life." . . . . . "As long as the conditions of life remain the same, we have reason to believe that a modification, which has already been inherited for many generations, may continue to be inherited for an almost infinite number of generations."—(*Ibid,* p. 466.)

EXAMPLES OF THE MANIFESTATION OF THE V.M.F. THROUGHOUT THE ANIMAL KINGDOM, UNDER VARIOUS CONDITIONS OF LIFE.

CLASS I.—INFUSORIA.

Order II.—Rhizopoda.

"*Genus Orbitolites.*—It has been shown that a very wide range of variation exists among Orbitolites, not merely as regards *external form*, but also as to *plan of development*; and not merely as to the shape and aspect of the *entire organism*, but also with respect to the size and configuration of its *component parts*."—(*Researches on the Foraminifera*, by W. B. Carpenter, M.D., F.R.S., etc., etc, *Philosophical Transactions*, vol. cxlvi. Part. I. 1856.)

"*Reparation of Injuries.*—Looking at that vegetative repetition of parts, which pre-eminently characterises the body of the orbitolite,—every one of the segments first budded-off from the nucleus, and subsequently from the margin of the pre-formed zones, being the precise repetition of every other,—it may be expected from the analogy of similar organisms, that every one of these parts should be equally capable, both of repairing injuries done to itself, and of maintaining an independent existence when detached from the mass to which it originally belonged. And although no opportunity has yet presented itself, of subjecting such a conclusion to the test of experiments devised for the purpose, yet *accident* has furnished the means of verifying it to a degree that could scarcely have been anticipated. For, in the course of my examination of the large collections which have been placed at my disposal, I have met with several specimens, in which it is evident that, after larger or smaller portions of the disk had been broken away, a new growth has taken place along the fractured edge."—(*Ibid.* p. 209.)

After describing and figuring various examples of the *reparation* of disks after fracture, and of the growth of new disks from detached fragments, Dr. Carpenter remarks: "This series of abnormal phenomena, then, not only confirms the conclusion, that seemed fairly deducible from our previous examination of

the normal modes of growth, with regard to the independent endowments of the component segments of the orbitolite body, but also affords some additional information of much interest. For we see, in the first place, that the growth of the sarcode, and the addition of new parts, may take place in the direction of the centre, where a free edge is exposed at the inner margin of any zone, as well as in the peripheral direction from the normal *outer* margin. Secondly, the reparative *nisus* seems always to tend towards the production of a disk, whose shape shall approach the circular, whatever may be the form of the fragment which serves as its foundation; thus showing that, notwithstanding the repetition and independence of the separate parts of these organisms, each cluster, whether large or small, is an integer, having an archetypal symmetry to which it tends to conform,—thus strongly reminding us of the laws of crystallisation. And, thirdly, the plan by which this recurrence to the discoidal form is provided for, seems partly to consist in the limitation of the new growth to the natural margins of the zones; no such growth taking place from the edge of a fracture which has crossed the zones transversely, although it may proceed from the remains of a zone which has been broken off by a fracture that partly follows its course."—(*Ibid.* p. 211.)

CLASS II.—POLYPS.

"Propagation is effected partly by eggs, partly by germs or buds; in many instances the last are not detached from the parent stem, and thus there arise compound animals, different individuals being connected."—(*Handbook of Zoology*, by J. Van der Hoeven. Translated from the 2nd Dutch Edition by the Rev. W. Clark, M.D., F.R.S., vol. i. p. 60. Cambridge, 1856.)

Order I.—Hydraformia.

"To the naked Polyps belong the well known armed Polyp of fresh water (Hydra). The body of this animal is hollow within, and terminates in a little cylindrical stalk that is without any opening. There is a single row of tentacles round the mouth which can be extended like long rays, or be contracted into little conical swellings. These tentacles are not all formed at once, but

at different times: their number is therefore indeterminate, and frequently varies in the same species. . . . . By their assistance the fresh-water polyp can creep along upon water plants or upon the bottom, overpower its prey, and convey it to the mouth. These Polyps are very voracious, and feed upon minute crustaceans, and upon worms, which frequently surpass them in bulk."—(*Ibid.* vol. i. p. 62.)

"We have seen above that propagation of Polyps is usually effected by buds. In *Hydra*, after being developed, they are separated: in others they remain attached to the parent-stem. But, besides this mode of propagation, a sexual generation has been observed in this class."—(*Ibid.* p. 68.)

"In *Syncoryne* and *Coryne*, and certain *Campanulariæ*, bell-shaped appendages or off-shoots have been noticed, which at length are separated from the stem, and resemble minute Medusæ. Conversely, also, the observations of Sars and Von Siebold have shown that Medusæ come from the egg under an oblong form resembling that of infusories beset with cilia: these move freely at first, then fix themselves, lose their cilia, become clavate, acquire arms, and perfectly resemble *Hydra*. These *Hydra*-like forms divide by transverse indentations, and separate into rings, from which Medusæ arise.

"It is possible, that all *hydra*-form Polyps may be only imperfect forms of *Medusæ*. And if so, those animals which Réaumur first named Polyps would no longer belong to this class. But, on this supposition, it is wonderful that *Spermatozoa* should be observed in *Hydra* and *Coryne*: a fact that may cause us to hesitate before we conclude, with Dujardin, that the eggs (described before, p. 68) are *Bulbilli*; at all events, the perfect form of *Hydra* would then be unknown."—(*Ibid.* p. 70.)

In the HYDRA VIRIDIS and FUSCA "any minute portion derived from the germ-mass may, after being separated from the perfect body, reproduce the perfect form."—(PAGET, *Lectures on Surgical Pathology*, vol. i. p. 157; TREMBLEY, ROESEL, &c.)

In the HYDRA TUBA, the species of which Sir J. G. Dalyell traced the development into Medusæ, "he found that, when cut in halves, each half may regain the perfect form."—(*Ibid.* p. 159.)

TABULARIA INDIVISA.—"A fine specimen was cut, near its root (by Sir J. G. Dalyell), and after the natural fall of its head, the

summit of its stem was cloven. An imperfect head was first produced, at right angles to the stem, from one portion of the cleft; after its fall, another and more nearly perfect one was regenerated, and, as it grew, improved yet more. A third appeared, and then a fourth, which was yet more nearly perfect, though the stem was thick, and the tentacula imperfect. The cleft was almost healed; and now a fifth head was formed, quite perfect; and after it, as perfectly, a sixth and a seventh head. All these were produced in fifteen months." When the experiment was completed, twenty-two heads had been produced in 550 days. — (*Ibid.* p. 161.)

Order III.—Polyactinia.

Actinina.—"Polyps affixing themselves by the part opposite to the mouth, loosening spontaneously and creeping or swimming, solitary, oviparous or viviparous, never dividing spontaneously, rarely gemmiparous."

Actiniæ, or Sea Anemones, "live on *crustacea, conchifera*, &c., swallow even occasionally large mussels, reject the shell, when the fleshy part has been extracted and consumed, by the mouth, and evert for this purpose their body, which they do likewise whenever they feel hunger. *Their reproductive power is almost as great as that of Hydra. If they are divided transversely, new tentacles after a few weeks are seen on the inferior portion, and each half becomes a perfect creature;* thus they may be propagated by fission, but propagation by spontaneous fission does not appear to occur naturally amongst *Actiniæ:* usually it is effected by *ova* which get into the stomach from the ovaries and are there developed; when the young ones come out of the egg they are rejected by the mouth."—(Van der Hoeven, vol. i. p. 90.)

CLASS IV.—ECHINODERMS.

In the development of Echinoderms "very remarkable differences are observed, according as more or less of the development is effected within the body of the parent, or according to the locality where the embryo is deposited on leaving the egg, or according to the different modes in which it is destined to acquire its food. As a general rule, it may be stated, that in littoral species when the embryo escapes at an early period from the egg

the *series of metamorphoses is less numerous:* but that in pelagic species, where the embryo has to seek its food by swimming on the surface, the *necessity for provisional organs of a complicated nature renders the changes very remarkable.*"—(Rev. W. CLARK, M.D., etc. VAN DER HOEVEN, vol. i. p. 135.)

"The power of reproduction in Echinoderms is very great. Star-fishes are frequently seen with one or more small arms or rays, that have been formed anew in consequence of the loss of the parts. Guettard and Bernard de Jussieu confirmed the reproduction by many experiments. In *Holothuriæ*, even viscera may be lost and formed anew; and some species are propagated by spontaneous division."—(VAN DER HOEVEN, vol. i p. 138.)

ORDER I.—PEDICULATE ECHINODERMS.

ASTERIÆ—SEA STARS.—"Sea stars can bend their rays towards each other, which is serviceable in moving through narrow fissures and between stones. They do not swim, but creep by means of their tentacles with mouth downwards. They feed principally upon molluscs."—(*Ibid.* p. 148.)

"Asteriæ have great capacity of restoring detached rays."—(PAGET, vol. i. p. 157.)

"The rays are easily reproduced; for the central disc and one ray will reproduce all the others."—(CUVIER, *Animal Kingdom*, BLYTH, CARPENTER and WESTWOOD's Edition, p. 639.)

HOLOTHURIDEA.—SEA SLUGS.

HOLOTHURIÆ feed upon *conchifera* and other marine animals; Tiedemann frequently found shells entire and uninjured in the intestinal canal of *Holothuria tubulosa*, so that the molluscs appeared to have been dissolved in the shell and digested. The bits of shell and the other matters unfit for use and undigested are rejected from the *cloaca* with the water in expiration.—(VAN DER HOEVEN, vol. i. p. 156.)

"In Holothuriæ, the intestinal canal is nearly of the same width throughout. It proceeds from the mouth along one side of the body to the lower extremity, then bends back to the anterior part, and finally descends along the other side to the cloaca, into which the respiratory organs also open."—(*Ibid.* p. 129.)

In some *Holothuriæ*, as in those which Tiedemann investigated, there are special respiratory organs. "The form of this respiratory organ agrees with that of Lung, although *Holothuriæ*

breathe water, and not air. These parts are very contractile : in a *Holothuria* that was opened alive they did not cease, as long as life lasted, to force the water in and out by alternate contraction and expansion. But, in respiration, it is not the contraction of the muscular membrane alone of these branches (of the respiratory organ) that acts, but the *contractility of the common integument of the body also.* This contractility of the skin is so great, that, occasionally, when the creature is irritated, a portion of the intestines together with the right branch of the respiratory organ is forcibly ejected from the cloaca."—(*Ibid.* p. 133.)

Sir J. G. Dalyell experimented upon Holothuriæ, and found that " when hurt or handled, they will eject all their viscera, leaving their body a mere empty sac, and yet, in three or four months, will have all their viscera regenerated."— PAGET, vol. i. p. 159.)

CLASS VII.—RINGED WORMS (ANNULATA).

" The *nervous* system in the *Annulata* proper consists, as in Insects, of ganglia connected by two cords and placed behind each other in a series in the middle of the body on the abdominal surface. Originally each ganglion consists of two lateral portions, as is proved by the process of development : on the regeneration, also, of parts that have been cut away, the nervous system appears to be formed of two lateral portions."—(VAN DER HOEVEN, vol. i. p. 216.)

ORDER I.—TURBELLARIA.

FAMILY I.—PLANARIÆ.—" The phenomenon of rotatory motion in the water surrounding these animals, which gave occasion to the name (*Turbellaria*), was first, it seems, observed by Dugès in *Planariæ*, although he did not refer it to cilia; whilst Von Baer observed, at the same time, another phenomenon, which could only be an effect of these cilia, that when one portion of these animals is cut off it continues to rotate circularly in the water.

" In the cavity of the mouth is situated a part that can be extended by eversion, serving for the seizure of food, and various in form. It is able, when severed from the living creature, to move independently for some time whilst it swallows greedily

surrounding substances, which are seen to pass out by the posterior open extremity as through a funnel.

"Respiration is probably effected by the skin itself, and the water on the surface is constantly renewed by the vibratile motion.

"A nervous system, in many a double nervous ganglion has been observed.

"The reproductive power is very great, and several parts grow, as appears from the observations especially of Dugès and J. R. Johnson, to new animals. In some, propagation occurs by spontaneous division."—(Van der Hoeven, vol. i. pp. 220, 221.)

Order III.—Setigera.

Naïs.—The Naïdina of Ehrenberg are a small natural group of worms, living principally in fresh water. "Besides propagation by eggs, these animals are also multiplied by spontaneous division."—(*Ibid.* p. 229.)

From the latest observations, as those of Leuckart and Schultze, it appears, "that the first and all-important step in the process of non-sexual multiplication in these animals, is the development of a bud between two rings nearly in the middle of the length of the body; so that this now consists of three portions, the anterior, the posterior, and the intervening bud. All the three become distinct individuals, the first by developing its tail, the last its head, and the bud the head-segments and anal portion in the same order of succession as in development from the egg. Previous to the separation of these three worms a new bud is usually formed in front of the middle worm, and in front of it a third bud, &c.; so that sometimes a chain of many connected individuals is met with which all receive nutriment (introduced by the mouth of the anterior member of the chain) from the intestinal canal common to them all. This process appears to have been observed in other families also (*Amphitritæ*, *Nereidæ*), but would seem in *all to be limited to the period preceding the sexual development*."—(Rev. W. Clark, M.D., F.R.S., &c.; Van der Hoeven, vol. i. p. 230.)

"The climax (of the experiments of Bonnet, Spallanzani, and others, on young Nereids, and on species of Nais) seemed to be achieved, when a Nais was cut by M. Lyonnet into thirty or forty separate pieces, and there were produced from these fragments as many perfect individuals."—(Paget, vol. i. p. 159.)

CLASS VIII.—INSECTA.

"We see, in the perfect insect, the manly period of life; in the larva, the childish period. Between the two, nature has interposed a deep sleep of development. The marriageable period is deadly for many. There are also many difficulties to be overcome. Some organs must for a time stand still; others (as for instance the silk-secreting tubes of caterpillars) must entirely disappear. The development of the sexual organs is essential, and for that everything must wait awhile; these remain during the larval state behind other organs; now they repress in turn by their development the activity of other organs. Finally, the perfect insect comes forth, in many respects a new creature. This is the true object of the phenomena of which the metamorphosis is composed, which is not so entirely unique in its kind as might be at first supposed. The perfect insect lives for propagation, and when it has attained that purpose of its being, it dies to make room for others, and serves for food to birds and other animals. Thus also an annual plant ceases to grow as soon as its bloom is developed, and dies when the seed is come to maturity."—(VAN DER HOEVEN, vol. i. p. 275.)

"The reproductive power in Insects which undergo metamorphosis is wanting in their perfect state; but if at an earlier period in the state of larva they have lost a foot, it grows out again at the next moulting, and is more or less perfectly restored. Also in the *Myriapoda*, excised antennæ grow again."—(VAN DER HOEVEN, vol. i. p. 276.)

"The sexes are distinct in all Insects. Union of the sexes must precede the laying of the eggs, if they are to prove fruitful. A remarkable peculiarity has been observed in Plant-lice (*Aphides*), where a single impregnation suffices for many families in succession; the males are not observed until the end of summer, or in autumn; they impregnate the last family, consisting of wingless females, which without copulation would be barren. Their eggs remain during the winter on branches of trees, and in spring produce only female Plant-lice which without copulation are prolific and viviparous. Bonnet, to whom we owe this discovery, found that in the space of three months nine successive generations were produced without copulation."—(*Ibid.* p. 264.)

Duvau has obtained even eleven successive generations with-

out copulation (*Ann. des Sc. Nat.* v. 1825, p. 224). There are also some examples of the same phenomenon in insects of other orders.—(BURMEISTER, l.l.s., 336, 337.)

ORDER I.—MYRIAPODA.

"Leach and other modern writers consider this order as a class, and wish the name of Insects to be restricted to six-footed articulate animals, of which the body consists of three principal parts: head, thorax, abdomen. Here there is no separation between thorax and abdomen, but the whole body is parted into rings. The reason why we have placed these insects at the beginning of the class, is to be found in their resemblance to the ringed-worms, to which they are related, not in their external form alone, but also in their internal structure; for even the six-footed insects which undergo complete metamorphosis often in the larval state approximate to the Myriapods.

"Myriapods, in the first period of their life, have fewer rings *and only three pairs of feet;* as they grow, new rings arise and the number of feet is augmented. In this respect also they resemble the ringed-worms, whilst in the metamorphosis of Insects the homologous parts, rings, segments, are not multiplied, but are developed unequally or are united, to form the different divisions of the body in the perfect Insect. The number also of simple eyes increases during the development of Myriapods."—(VAN DER HOEVEN, vol. i. p. 289)

After the escape of the young from the egg, "they continue to adhere for some days by a string to the shell, which has burst longitudinally, without motion, and surrounded by a proper membrane; at that period they have no legs at all; as soon as they have got three pairs of feet they separate themselves from the shell; they have now a great resemblance to the larvæ of some *Coleoptera;* soon the number of rings and feet begins to be increased in that part of the body which is seated in front of the penultimate ring."—(VAN DER HOEVEN, p. 292.)

"These Insects live in obscure places, under the bark of trees, and on the ground under fallen leaves, stones, etc.

They "live principally on vegetable food; some also eat dead earth-worms and small molluscs."—(*Ibid.* p. 291.)

"Some Myriapods (*Scolopendridæ*) live on animal food, insects, etc. Their nippers containing the excretory duct of a poison

gland, which secretes a fluid deadly to small animals."—(De Geer, *Insect.* 7, p. 557, *on the bite of Lithobius forficatus;* Latreille, *Hist. des Crust. et des Ins.* 7, p. 88, *on the bite of Scutigera araneoides.*)

In some Myriapoda "the feet readily fall off, as in gnats and harvest-spiders."—(Van der Hoeven, p. 294, vol. i.)

In the experiments of Newport on Julidæ (niger and terrestris), *Phil. Trans.* 1844, an individual two-thirds the adult size, having had its antennæ and some legs cut off, completely reproduced both the antennæ and legs at the succeeding change of skin and addition of new segments to the body, described by Van der Hoeven, p. 292, vol. i.

Other individuals, much nearer the adult state, had their antennæ and some of their legs cut off. In these the reproduction was delayed for some months; but, at their next hybernation during which they changed their skins, the lost parts were reproduced.

Similar experiments on Lithobii showed, that the reproduction of lost parts takes place at the change of skin and addition of new segments as in Julidæ; several changes of skin are required before the reproduced parts are perfected, and although they may thus at length attain the full size, they never acquire a perfectly normal development of all their parts.

Order VIII.—Lepidoptera.

The antennæ of these insects differ in form.

"The metamorphosis is complete (ovum, larva, pupa, imago). The larvæ are called *caterpillars.* The body of caterpillars consists of twelve rings exclusive of the head. There are on each side nine air-slits; for the second, third, and last ring are without them. The normal number of feet in caterpillars is eight pairs; the fourth, fifth, tenth, and eleventh ring have no feet. On the first three rings three horny feet are placed, which have a conical form, and consist of joints; the last joint has the

form of a bent nail. These six feet answer to those of the perfect insect. The remaining ten feet (some species have only eight, six, or four) are membranous and without joints; they disappear in the perfect insect. . . . . Most caterpillars live on vegetable food, especially leaves; . . . others, however, eat leather, fur, wax, fat, etc., and these belong especially to the family of moths. Caterpillars usually change the skin four or five times before turning into pupæ.

"Lepidopterous insects, in the perfect state of butterflies, either take no food at all, or suck the sap of flowers."—(VAN DER HOEVEN, vol. i. p. 391-2).

The experiments of Newport on Vanessa urticæ, and afterwards on Vanessa Io, gave the following among other results.—(*Phil. Trans.*, 1844) :—

The removal of the limbs of the larvæ at their last change of skin and at the one before the last, does not necessarily prevent them from changing into the pupa state.

Out of a number of larvæ experimented upon by removal of legs, or portions of legs; one, in which a portion of the posterior leg had been removed at the tibial joint, had the lost portion reproduced with the tarsus and claw at the change of skin (the reproduction was not perfect). When the others had become pupæ, "most of them gave distinct evidence of reproduction having taken place." When the imago escaped from the pupa, in two, no reproduction of limbs had taken place; but in six, reproduction of the limbs lost by the larvæ was complete.

ORDER XI.—ORTHOPTERA (*Metamorphosis incomplete*).

"All the *Orthoptera* hitherto known are terrestrial during the different states of metamorphosis. Some are carnivorous or omnivorous, but the greater number feed on plants. But some species often appear in great numbers, and are very ravening, and may cause terrible devastation; this is especially the case with the locusts."—(VAN DER HOEVEN, vol. i. p. 449).

SPECTRA (*Phasmida Leach*).

PHASMA.—These insects "live on vegetable food. Some wingless species have the form of dried twigs, and others, which

are flat, with membranous and vein shield-covers, have a great resemblance to leaves."—(*Ibid.* p. 458.)

Phasmæ have, in their early life, a power to reproduce lost legs.—(Baly's *Müller*, 1837.)

This is confirmed by the experiments of Mr. Fortnum on *Diura violescens*, and by Newport on *Alopus cocophages*.

Blattariæ.

Blatta.—"Antennæ long, setaceous. . . . . Feet all similar, long. Tibiæ provided with spinules, moveable."—(Van der Hoeven, p. 461.)

The experiments of Dr. Heincke (*Zoological Journal*, vol. iv. p. 422) show that Blattæ have the power, in their young state, to reproduce antennæ.

CLASS IX.—ARACHNIDS (Arachnoidea).

"Articulate animals, with articulate feet or legs, and without antennæ. Feet eight, placed at the sides of the cephalo-thorax; abdominal feet, none."—(Van der Hoeven, vol. i. p. 571.)

When first evolved from the egg, "the young spider, through whose integuments the granules of the yolk may be clearly distinguished, is not yet in a state to weave a web, and catch its prey; for the spinning organs are still concealed beneath the common integument. After the lapse of a week, or, in some species, a longer time, *during which the spider takes no food*, it casts its skin for the first time, and is, as it were, born for the second time. The young spiders now quit, on some mild day in May or June, the web in which the mother had hidden her eggs. . . . . .

"Most Arachnids feed on other animals, which they either swallow alive, or whose blood and fluids they suck. Usually, after their escape from the egg, they undergo no metamorphosis. They, however, cast their skin more than once, and are commonly in a state for pairing after the fourth or fifth moult. In most *Acarina*, the young animals are at first supplied with only three pairs of feet. . . . . The *Pycnogonida* and the genus *Hydrachna* present the most interesting changes of form.

"The power of reproduction in Arachnids is commonly considered to be small. In many, however, lost feet can grow again. Thus Geoffroy once saw a Phalangium, in which one foot was less than the remaining seven, and which, probably, might have grown at a later period. At all events, it is established that, in spiders, lost feet are regenerated."—(VAN DER HOEVEN, pp. 566, 567.)

If a spider is seized by the leg, and allowed to struggle and to escape with the loss of the leg, the separation takes place at the junction of the femur with the coxa; if by any chance a limb is broken at any other part, the animal attempts to break off the stump at the junction of the femur with the coxa, in which it generally succeeds.

"The legs of spiders can be reproduced when they have been torn off. This reproduction can only take place when the limb has been detached as high as the moveable base (junction of the femur with the coxa); for, otherwise, hæmorrhage supervenes which kills the animal. The reproduction takes place only at the time of the moult, and the new leg is at first slender, but with all its parts or joints, each of which has acquired its natural relative size."—(Observations of LEPELLETIER and AUDOUIN. TODD'S *Cyclopædia*, vol. i. p. 216.)

"M. Saint Fargeau observed that spiders possess the power of renewing lost limbs."—(CUVIER, *Animal Kingdom*. BLYTH, CARPENTER, and WESTWOOD'S ED., p. 455.)

CLASS X.—CRUSTACEANS (CRUSTACEA).

"Many Crustaceans make their appearance from the egg with fewer limbs than they afterwards possess. But the development of Crustaceans presents many differences in the different orders, of which the particular description would demand too large a space. . . . . .

"In very many Crustaceans extremely remarkable metamorphoses have been observed, which, however, *are confined to the first period of life*. Long before they are full grown they have attained their permanent form, and after that only undergo repeated moultings.

"The young of *Cyclops*, already observed by Leuwenhoeck and afterwards by De Geer, are so unlike in form to the parent animal, that O. F. Mueller formed distinct genera of them. . .

"Young individuals of *Ergasilus*, *Achtheres*, *Lernæocera*, present similar forms, with four or six feet, according to the observations of Nordmann."—(VAN DER HOEVEN, vol. i. pp. 612, 613.)

"The larvæ of *Cirripedia* pass through three different stages."—(DARWIN, *Lepadidæ*, pp. 8—25.)

"The Crustaceans cast their shell several times. In younger individuals, these moultings succeed each other at shorter periods; but in full-grown animals, at least in the Decapods, the hard calcareous shell is cast off only once a year. . . . . .

"As long as the new shell is still thin and flexible, the crays and crabs are very sensitive. They then conceal themselves in holes, until the new shell has attained sufficient hardness, for which a few days only are requisite. With the shell, the inner coat, or the *epithelium*, of the stomach is renewed in the crays and crabs."—(VAN DER HOEVEN, vol. i. p. 615.)

"The power of restoration or reproduction is very great in this class, so that even feet, amputated or broken off, are replaced by new ones."—(*Ibid.* p. 616.)

"In Art-instincts, the Crustaceans appear to stand below most insects and Arachnids. In them, the vegetative or organic life is more developed than the animal."—(*Ibid.* p. 620.)

ORDER IV.—CIRRIPEDIA.

"Cirripeds are found in the seas of every region of the world, they attach themselves to rocks, to many marine animals as shell-fish, turtles, whales, to different polyparies, to marine plants, to the hulls of ships, to the floating wreck of vessels that have been lost, as fragments of wood, bottles, etc."—(*Ibid.* p. 635.)

"The larvæ of some Cirripedia, in the *first* stage, have three pairs of legs, a very simple single eye, and a probosci-formed mouth, with which they feed largely, for they increase much in size. In the *second* stage, answering to the chrysalis stage of butterflies, they have six pairs of beautifully constructed natatory legs, a pair of magnificent compound eyes, and extremely complex antennæ; but they have a closed and imperfect mouth, and cannot feed. Their function at this stage is to search, by their well-developed organs of sense, and to reach, by their active

powers of swimming, a proper place on which to become attached and to undergo their final metamorphosis. When this is completed, they are fixed for life. Their legs are now converted into prehensile organs, they again obtain a well-constructed mouth, but they have no antennæ, and their two eyes are now reconverted into a minute, single, and very simple eye-spot."—(*Origin of Species, etc.*, by CHARLES DARWIN, p. 440.)

CLASS XIII.—MOLLUSCS (MOLLUSCA.)

"The animals of this class have a head more or less distinct from the rest of the body. This head usually contains special organs of sense for touch and vision, sometimes even for hearing. Many of these animals have a shell; others are naked. Most of them live in water, but some on land."—(VAN DER HOEVEN, vol. i. p. 758.)

"In the organs of propagation in molluscs great variety prevails. Some are bisexual; others have distinct sexes."—(*Ibid.* p. 763.)

"Most molluscs are oviparous; only a few as *Paludina Vivipara*, and *Clausilia Ventricosa*, are viviparous. . . . . The power of restoration is, in some species of this class, very great. In various *Helices*, the reproduction of the head that has been (partly) excised, and of antennæ, has been observed by Spallanzani, Senebier, and Bonnet. That the entire head grows again, as the experiments of Spallanzani appeared to indicate, may however be doubted, since the anatomical investigation of such snails as had been preserved by this observer in spirit afterwards proved that, by the excision, the first or cerebral ganglion had not been removed.—(*Ibid.* p. 765.)

CLASS XIV.—FISHES (PISCES).

"All the bony fishes whose development has been hitherto observed, quit their egg-covers at a very early period and whilst still imperfectly formed. In the embryos of sharks and rays the filaments which hang freely from the branchial fissures, productions of the internal leaflets of the gills, reminding us of the

external gills of larvæ of Salamanders, are especially deserving of regard."—(Van der Hoeven, vol. ii. p. 41.)

"The restorative power of fishes is limited to the reproduction of the parts of fins which have been removed. Many fishes may attain a great age. . . . . In general they seek their food, especially marine fishes, by night, and then are most easily captured."—(*Ibid.* p. 52.)

"Progressive motion is effected by the tail striking alternately right and left against the water (for which purpose the flexure of the spine is lateral, whereas in the other vertebrata the principal flexure is vertical), and perhaps the jet of water thrown backwards from the gill-openings may assist. Thus a fish has but little use for extremities; and the parts analogous to legs and arms are accordingly very short, terminating in what are called fins."—(Cuvier's *Animal Kingdom*, Blyth, Westwood, and Carpenter's Edition, p. 290.)

CLASS XV.—REPTILES (Reptilia).

"The Reptiles are vertebrate animals, mostly oviparous and cold-blooded, that breathe by lungs. Some breathe at first by gills, which afterwards disappear, when the lungs have been developed; whilst in a few, during the whole life, there are both gills and lungs."—(Van der Hoeven, vol. ii. p. 206.)

"In the development of the animals of the present class there is a remarkable difference; those reptiles which have a smooth skin and at first breathe by gills, or which have both lungs and gills (*diplopnoa*), resemble fishes in the development of the embryo, for neither *amnion* nor *allantois* is formed. In the *haplopnoa*, on the other hand, that is in those which breathe by lungs from the beginning and never possess gills, as the serpents, lizards, and tortoises; there is formed in the *embryo*, as in birds and mammals, an *amnion* and an *allantois*. In the *diplopnoa* there is no external yolk-sac constricted by the abdomen; the animal leaves the egg in a still very imperfect condition, as a larva without limbs and with external gills, and the development continues after birth, until the lungs arise, and with them the circulation of blood is changed. In the other reptiles, the *embryo* leaves the egg in a much more perfect state. The development

of the young in the egg is effected, according to different external circumstances of temperature, etc., in different periods of time. In many serpents and lizards, the development begins, before the egg is laid, in the body of the parent, and in some the membrane of the egg is broken by the young one before birth. In the tortoises, on the contrary, development begins after the egg has been laid, and is completed only after the lapse of several weeks." —(*Ibid.* p. 225.)

"The casting or moulting of the cuticle is very general in the naked *diplopnoa*; in the serpents the external covering of the eye-ball is moulted with the cuticle."—(*Ibid.* p. 229.)

"The intelligence of Reptiles is very feebly developed, and, in this respect they stand scarcely on a higher footing than fishes. They grow slowly and live long. In temperate and cold regions they undergo hybernation or winter-sleep; perhaps many in warm climates have summer-sleep, whilst the rainy season causes them to emerge again from their concealment. They are very tenacious of life; some remain alive for months in captivity without food; they can endure great heat and cold. The irritability of the muscles persists for a long time after death, as it also does in amputated parts of the animal. The reproductive power is very great, especially in water-salamanders; in these not only the tail and legs that have been removed grow again, but the eye also can be restored, if only the entire ball as far as the optic nerve be not cut away."—(*Ibid.* p. 234.)

Order II.—Saurobatrachii.

Family III.—Salamandrina.—"Respiration in the perfect state solely pulmonal; external branchiæ in larvæ. Eyes with distinct eyelids, moderate. Four feet, with carpus and tarsus osseous in most, etc."—(*Ibid.* p. 242.)

"Triton (Water-salamander).—In the Water-salamanders the eggs are impregnated before being laid. The female deposits her eggs on aquatic plants, and folds every leaf to which she has attached an egg in such a way that its under surface is turned inwards, the plait or fold being caused to stick together by the gelatinous covering of the egg. The European species usually lose their gills as early as the third month; but if they have not lost them on the approach of winter, they retain them the winter through, and themselves continue to grow. They are not capable

of propagating till the third year. The larvæ feed on aquatic insects, molluscs and worms, as do the adult animals. Many species in the adult state live both on land and in water."—(*Ibid.* p. 244.)

Spallanzani experimented upon Tritons, and observed the same limbs reproduced many times after mutilation, and an eye reproduced after it had been removed.

Order III.—Batrachii.

"All are oviparous. The larvæ of these animals breathe by internal gills; during the first period of time external gills also are present, as in the larvæ of salamanders. . . . . They disappear a few days after birth, and then the internal gills alone remain. . . . . The larvæ, which at first have no limbs, shew their hind legs first; the tail, very large in some, disappears slowly by resorption, which proceeds from the point to the base." —(Van der Hoeven, ii. p. 245.)

The larvæ or tadpoles of the frog (*Rana temporaria*) reproduce their tails when mutilated, and this most readily, at an early period of life, when they are the only means of locomotion.—(Spallanzani, and others.)

"The limbs of the Tadpole reproduce the parts of them that have been mutilated, nearly as in the Newts."—(Cuvier's *Animal Kingdom*, edited by Blyth, Westwood and Carpenter, p. 286.)

Order V.—Saurii.

Anguis fragilis.—"The blind-worm or slow-worm. . . . . The tail, which is variable in length (often as long as the trunk), is easily broken off. The slow-worm is *viviparous*; feeds on slugs, insects and earth-worms; hides, in winter, underground and then becomes torpid."—(Van der Hoeven, vol. ii. p. 284.

The tail of the Ophisaurus is brittle, like that of the slow-worm.

Lacertæ.

Lacerta agilis.—"Feeds on insects, and enjoys basking in the sunshine; the female lays from five to eight eggs, which are said

to emit light for a time in the dark. Another still smaller European species (*Lacerta vivipara*) is viviparous, or the young come to view immediately the eggs are laid."—(VAN DER HOEVEN, p. 295; BELL'S *British Reptiles*.)

Lizards reproduce lost portions of their tails, but the new part contains a cartilaginous column in place of perfect vertebræ.—(CARPENTER'S *Comp. Physiology*.)

CLASS XVII.—MAMMALS (MAMMALIA).

"Vertebrate animals, breathing atmospheric air by lungs; with red, warm blood, heart with two auricles and two ventricles, viviparous, lactating, furnished with a muscular diaphragm, covered by skin mostly hairy, armed more rarely with spines, sometimes partly mailed by scales."—(VAN DER HOEVEN, vol. ii. p. 609.)

"The intellectual power is more developed than that of any other animals."—(*Ibid.* p. 603.)

It would occupy too much space, to attempt to enumerate the examples that might be collected of the different reproductive and reparative processes that occur in the organisms of mammals; and, as they are familiar to those who have studied physiology and pathology, it will not be necessary to do more than mention a few, to which reference is made in these Lectures.

In the repair of fractures of bone, a great contrast occurs between the time occupied by the process in man, and in the lower mammals whose existence is more dependent upon the completeness of their members. Thus, in dogs, rabbits, pigeons, and other animals which have been experimented upon, "an abundant reparative material will be produced and organized into cartilage or bone, in a time little longer than elapses before the first commencement of the process in man."—(*Lect. on Surg. Path.*, JAMES PAGET, F.R.S., vol. i. p. 242.)

ORDER V.—RUMINANTIA.

CERVUS.—The antlers of the stag are periodically moulted and

reproduced. "The horns of the deer are bony excrescences, which are developed on a cylindrical process of the frontal bone. This process is covered with skin and hair; it appears, shortly after birth, as an *epiphysis* upon the skull, with which it speedily coalesces. . . . . At the point of this rose-stock (the non-deciduous part of the horn) is developed, after the second year, the horn, which is shed annually. The growth of the horns proceeds rapidly, so that in a few weeks they attain their full size. . . . . The females, with the exception of the rein-deer, have no horns; but in old females they are observed sometimes. . . . . When stags are castrated, the horns are not developed, or, if they had been developed before the operation, they are not cast any more."—(VAN DER HOEVEN, vol. ii. p. 647.)

ORDER VIII.—FERÆ.

SECTION II. — CARNIVORA.

CANIS FAMILIARIS.—Tiedemann and Gmelin placed a ligature upon the biliary duct in a dog, and a new duct was formed to connect the separated portions.

Bernard placed a ligature upon the pancreatic duct of a dog, and a new duct was formed to connect the separated portions.

Sedillot and Blondlot performed similar experiments, with similar results, upon the œsophageal tubes of dogs.—BERNARD'S *Lectures on Experimental Physiology*, "Medical Times and Gazette," 1860. Lecture 10.

ORDER XII.—BIMANA.

"Although man, as a moral and reasoning creature, is raised far above the animals, yet when his bodily structure is contemplated, no characters can be indicated which remove him from the class to which he is here referred.

"Man is distinguished by his erect gait. . . . . His hand is more unrestricted in the motion of the fingers, and is for him an *instrument of instruments*, as it was named by Aristotle. The brain has a great preponderance over the nerves and the

spinal cord, of which the large amplitude of the human cranium as compared with the face is a consequence; man has the largest facial angle.

"Man is further distinguished from animals by speech. . . Through it he possesses a history, a tradition of experience; a progressive education, which is imparted by this tradition to succeeding generations."—(VAN DER HOEVEN, vol. ii. p. 757.)

"In man and other mammalia, a true reproduction after loss or injury occurs in three classes of parts:—

1. "Those which are formed entirely by nutritive repetition; such as the blood and the epithelia.

2. "Those which are of lowest organisation, and (which seems of more importance) of lowest chemical character; as the gelatinous tissues, the cellular and tendinous, and the bones.

3. "To those which are inserted in other tissues, not as essential to their structure, but as accessories, as connecting or incorporating them with the other structures of vegetative or animal life; such as nerve-fibres and blood-vessels."—(*Lectures on Surgical Pathology.* By JAMES PAGET, F.R.S., vol. i. p. 164.)

"The reparative power is greater in all parts of the young than in those of the older individuals of all species. Even when we compare individuals that have all attained their highest development and growth, this rule seems to be true."—(*Ibid.* p. 154.)

"Re-formation of a whole bone may occur, when the original has been destroyed by disease, with all the attachments of muscles, ligaments, &c., as complete as before."—(CARPENTER'S *Principles of Physiology, Comp. and General,* 3rd Edit., p. 872.)

"The author has been assured by a very intelligent surgeon, that he was cognisant of a case in which the whole of one ramus of the lower jaw having been lost by disease in a young girl, the jaw had been completely regenerated, and teeth were developed and occupied their normal situations."—(CARPENTER, *Principles of Human Physiology*, p. 333. 5th Edit. 1855.)

Dr. Simpson exhibited to the Physiological Section of the British Association, 1850, specimens, showing that, after spontaneous amputation of the limbs of the human fœtus, in utero, at an early period of gestation, fingers had been reproduced on the ends of the stumps left by amputation.

Cases are on record, in which supernumerary fingers were reproduced several times successively, after careful removal; and this took place, notwithstanding that care was taken, by the surgeons, to remove the *whole* of the supernumerary member.—(*See* WHITE, *on Regeneration of Animal and Vegetable Substances*, p. 16, 1785; and CARPENTER, *Principles of Comp. and General Physiology*, 1851. *Principles of Comp. Phys.*, p. 480. 1854.)

"In all the vertebrata, two sets of red corpuscles are developed at different periods of life: a first set, which exist alone in the blood, till lymph and chyle begin to be formed; and a second set, which are formed from the lymph- and chyle-corpuscles, and gradually supersede the first set. The corpuscles of the first set are, in the first instance, part of the embryo-cells which form the mucous or vegetative layer of the embryoes in Mammalia and Birds, and the whole inner surface of the vitelline membrane, in the embryoes of fish and reptiles. . . . . Each cell has a central nucleus."—(p. 63, *Handbook of Physiology*, 4th Edition, 1860. By W. S. KIRKES, M.D., etc.)

"In mammalian embryoes, also, the earliest blood-corpuscles appear to be a portion of the cells of the vegetative or mucous layer of the germinal area. They are large, spherical or oval, pellucid and colourless, nucleated, and full of minute granules. In these we have observed (as Kölliker and others have done), a process of multiplication by bi-partition of the nucleus, each half of which, either by appropriating half the cell, or by developing a cell around itself, becomes the central nucleus of a new cell differing from the parent-cell from which it escapes, in little except in being smaller and generally circular."—(*Ibid.* p 63.)

"When, in the development of the embryo, the lymph and chyle begin to be formed and added to the blood, their corpuscles are developed so as to supersede those produced in the manner just described. . . . . After they have once appeared, the new blood-corpuscles appear to be derived exclusively through them. . . . . Gradually, while the corpuscles of the second set are increasing, those of the first disappear."—(*Ibid.* p. 65.)

HEADINGS OF THE FORM OF REPORT EMPLOYED FOR CASES FROM 1852 TO 1854.

(1)

SUMMARY OF THE CASE.

Name . . . . . .
Age . . . . . .
Height. . . . . .
Weight . . . . . .
Married . . . . . .
Occupation . . . . . .
Date. . . . . .

(2)

FAMILY HISTORY OF THE FIRST GENERATION.

(*Grandparents of the Patient named No.* 1.)

Age and Cause of Death of the *Father* of the Father of the Patient.
" " *Mother* of the Father " "
" " *Father* of the Mother " "
" " *Mother* of the Mother " "

If any particular idiosyncrasies can be traced to either Grandparent, state them here.

(3)

FAMILY HISTORY OF THE SECOND GENERATION.

(*Parents of the Patient named No.* 1.)

Mother of the Patient.—Which Parent did she resemble?

Had she any peculiar idiosyncrasy?
What was her age, the condition of her health, and, if dead, the cause of death?
Had she any Brothers?
What were their ages, family resemblances and health?
Had she any Sisters?
What were their ages, family resemblances, and health?

Father of the Patient.—Which Parent did he resemble?
Had he any peculiar idiosyncrasy?
What was his age, and the condition of his health?
If dead, the cause of death?
Had he any Brothers?
What were their ages, family resemblances, and health?
Had he any Sisters?
What were their ages, family resemblances, and health?

(4)

PERSONAL HISTORY OF THE THIRD GENERATION.

First Cousins of the Patient.

If either paternal or maternal Uncles or Aunts of No. 1 have children, state their health, etc.; or, if dead, the causes of death.

Personal History of the Patient named No. 1.

Which Parent or Ancestor does No. 1 resemble?
Which Brother or Sister does No. 1 resemble?
Has he or she any peculiar idiosyncrasy, and to which ancestor can this be traced?
How many Brothers?
What are their ages, family resemblances, and health?
How many Sisters?
What are their ages, family resemblances, and health?

The Embryonic Development, Birth, and Infancy of the Patient named No. 1.

What was the condition of health of the Mother of the patient No. 1 from the 21st to the 9th month previous to the birth of No. 1 ?

What was the condition of health of the Mother of No. 1 during the nine months previous to the birth of No. 1 ?

What was the condition of health of the Father of No. 1 from the 21st to the 9th month previous to the birth of No. 1 ?

What was the condition of No. 1 at birth ?

What was the health of the Mother or Nurse during the lactation of No. 1 ?

What was the state of health of No. 1 during lactation ?

How was weaning conducted ? At what age ?

From Weaning to Seven Years.

What was the food ?

What was the dwelling ? Clothing ?

How was teething effected ? Growth ?

From what diseases did No. 1 suffer, and was there anything peculiar in the treatment adopted ?

How was education conducted ?

From Seven Years to Puberty.

Food ? Dwelling ? Clothing ? Teething ? Diseases ? Education ? Growth ?

From Puberty to Twenty-one Years.

At what age did puberty occur ?

Were there any peculiar indications of disease during its occurrence ?

Food ? Dwelling ? Clothing ? Occupation ? Diseases ? Education ? Habits ? Growth ?

From Twenty-one Years to the Present Time.

Food? Dwelling? Clothing? Occupation? Habits?
Diseases?

(5)

PRESENT CONDITION OF THE PATIENT NAMED No. 1.

Married?
At what age?
How many children?
What is the present condition of No. 1?

(6)

PERSONAL HISTORY OF THE FOURTH GENERATION.

The Children of No. 1.

The Nephews and Nieces of No. 1.

HEADINGS OF THE FORM OF REPORT EMPLOYED FOR CASES FROM 1854 TO 1858.

Case *Date* *Class*
The Patient's own complaint in answer to the question: What is the matter? .
Name—Age . . . . .
Situation of Dwelling . . . . .
Ditto Birthplace . . . .

Answers to questions as to functions. | Are these the Habitual Conditions?

Intestinal . . . . . .
Urinary . . . . . .
Genital . . . . . .
Digestive . . . . . .
Muscular . . . . . .
Nervous . . . . . .
Intellectual . . . . . .
Respiratory . . . . . .
Circulatory . . . . . .

Analyses and Microscopic Examinations
Habits and Occupation, present and past . . . . . .
Diseases suffered from within memory .
Do any kinds of food, medicine, or meteorological conditions act peculiarly?
General description, Height, and Weight.
Which relative resembled in face or figure? . . . . . .

Family History.

Father . . . . . .
Mother . . . . . .
Brothers . . . . . .
Sisters . . . . . .
Uncles and Aunts { Father's side . . .
Mother's side . . .
First Cousins { Father's side . . .
Mother's side . . .

Are these the Habitual Conditions?

Skin and Animal Heat . . .
Pulse . . . . . .
Number of Inspirations per minute .
Tongue . . . . . .
Fauces . . . . . .
Eyes . . . . . .

Chest—Development . . . .

		Percussion	Auscultation
Right Lung Anteriorly	Upper Lobe .		
	Middle . .		
	Lower . .		
Posteriorly	Upper Lobe .		
	Middle . .		
	Lower . .		
Left Lung Anteriorly	Upper Lobe .		
	Lower Lobe .		
Posteriorly	Upper Lobe .		
	Lower Lobe .		

Heart.

Position of Impulse
Dulness . .
First sound . .
Pause . . .
Second Sound .
Pause . . .

Blood-vessels . . . .
Liver—Its boundaries, etc. . .

Kidneys . . . . .
Stomach . . . . .
Intestines and other Abdominal and Pelvic Organs . . .
Additional Remarks . . .

At each future interview with the patient, report the nature of the complaint for which he seeks relief. When discharged from treatment, report what vestiges remain.

In case of death, give post mortem appearances, if possible.

THE END.

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2. Conglomerated interstitial tuberculous granulations.
3. Infiltrated tubercle.
4. Apoplexy of the lung after coagulation.
5. Healed cavities, fibro-cellular cicatrices, and chalky concretions.
6. First stage of pneumonia.
7. Second stage of pneumonia.
8. Second stage of pneumonia passing into the third.
9. Medullary cancer.
10. Hard cancer.
11. Melanoid cancer.
12. Indurated lung, the effect of pneumonia.

LIQUEFACTIONS.—

13. Second stage of acute bronchitis.
14. Chronic bronchitis.
15. Third stage of pneumonia.
16. Second stage of tuberculous disease.
17. Apoplectic coagula in the lung, softening.
18. Apoplexy of the lung before coagulation, with and without laceration.

EXCAVATIONS.—

19. A large empty tuberculous cavity, with reflecting walls, free bronchial communication, and consolidated surrounding lung.
20. A similar cavity containing secretion.
21. A very superficial cavity, full of air.
22. Small tuberculous cavities, beneath a stratum of normal lung.
23. A large tuberculous cavity, beneath a thick stratum of densely-consolidated lung.
24. Emphysema (vesicular).
25. Bronchiectasis.
26. A gangrenous cavity.
27. A pneumonic abscess, partly emptied.

PLEURISY, PNEUMOTHORAX, ETC.—

28. Normal lung, showing the interior of the bronchial tubes.
29. First stage of acute bronchitis.
30. First stage of acute pleurisy.
31. Second stage of acute pleurisy.
32. Third stage of acute pleurisy, compressed and displaced lung.
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